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SURGERY OF DEFORMITIES.

Menders of the Maimed: The Anatomical and Physiological Principles Underlying the Treatment of Injuries to Muscles, Nerves, Bones, and Joints. By Prof. A. Keith. (Oxford Medical Publications.) Pp. xii + 335. (London: Henry Frowde; Hodder and Stoughton, 1919.) Price 16*s.* net.

PROF. KEITH'S book is undoubtedly one of the most interesting and instructive which have yet been written on this important branch of surgical work. The author treats the subject from an entirely new point of view; instead of following up each forward step and discussing the influence which the various workers in this field had on that progress, he gives us a *résumé* of the career of the workers who made this advance possible.

Nothing could be clearer or more concise than the way in which Prof. Keith has selected from the career of the men who are chiefly responsible for this progress the various points of importance in making us understand the influence which these men had on the progress of the surgery of deformities.

The book enables us to understand how great was the handicap under which these pioneers had to conduct their studies. It shows us how two men such as John Hunter and Hugh Owen Thomas, whilst working in widely different fields, the one finding most of his data in the dissecting room and the other gathering all his observations from clinical studies at the bedside, each arrived at practically the same conclusions in regard to the healing of wounds and the cure of disease.

These are two men who in their practice had found that the proper treatment for inflamed or injured bones or soft tissues was not the method of movements and massage which was the popular one in their time, but fixation, which promotes rest of the tissues and allows Nature's reparative changes to come unhindered into action.

Hunter perhaps better than any other clearly defined the relationship between fixation and massage in an injured or diseased joint in the principle which is enunciated in his book on "Diseased and Wounded Joints respecting their Motion," in which he states that "nothing can promote contraction of a joint so much as motion before the disease is removed."

The subject with which Prof. Keith deals is one that has always interested surgeons, and although of late years the great advances which have been made in abdominal surgery have tended to overshadow this important branch of surgery, yet no more opportune moment could have been selected for the publication of this work.

The hundreds, or rather thousands, of soldiers and ex-soldiers who are to-day walking about in our cities with deformities of joints, with malunited fractures, or with paralysis of one or more limbs are a constant reminder of the importance of a clear grasp of the principles for the treatment of these injuries.

The great disadvantage under which a medical man labours at the present time is that he can find in no library a trustworthy history of the work of those who have gone before him in any special field. The result is that careful and capable workers in some special branch of surgery or medicine are often found struggling with the solution of a problem which has already been solved, or proved by the work of a forerunner to be of little importance.

This is where Prof. Keith's book is of such great value. He forces us to realise the work which has been accomplished by the men who were the pioneers in the art, and in a few all too short chapters follows up that progress through the careers of those who followed.

No part of the book is better conceived than the chapters which Prof. Keith has devoted to the growth of bone and the practice of bone grafting. Here we follow down through the years the gradual increase of knowledge from the work of Goodsir and Syme to that of Albu and Hey Groves. We see how each succeeding investigator added in some way to what was known of the subject, and built up our present knowledge, which is daily increasing and changing.

At no time in the history of the subject has there been such an immense number of cases on which this problem of bone regeneration and bone transplantation can be studied, and in many cases fractures have occurred of a bone graft soon after its implantation, with a subsequent union of the parts of the graft.

The book is intended primarily as a *résumé* of the history of the subject, and does not enter into a discussion of treatment except in the broadest sense of the term, and perhaps its one weak spot is the short discussion on the relative values to be placed on different lines of treatment.

This is seen in the remarks on the relative advantages of the treatment of fractures by means of plating as compared with non-operative methods. Here Prof. Keith follows entirely the report of a commission, and from the purely theoretical point of view decides that the results of the treatment of fractures by plating is superior to those obtained by splints, etc., and does not realise that we are comparing the work of the best surgeons on the

staff of a hospital, who alone would perform the operation, with, in many cases, the work of a newly qualified house-surgeon.

In many respects the book fills a gap in medical literature, and will be of great help not only to the general body of medical workers, but also more particularly to those who are specially engaged in this line of work.

THE OIL-HARDENING INDUSTRY.

The Hydrogenation of Oils: Catalysers and Catalysis and the Generation of Hydrogen and Oxygen. By Carleton Ellis. Second edition, thoroughly revised and enlarged. Pp. xvii+767. (London: Constable and Co., Ltd., 1919.) Price 36*s*. net.

"FAT hardening" and "hydrogenation" are the trade terms for the chemical process of saturating liquid oils with hydrogen in presence of finely divided nickel. These operations, which a few years ago were conducted with great secrecy, are now regarded as more or less normal in every soap factory, and the usual extensive literature has grown up to describe them. Much of this is naturally diffuse, and much again inaccurate, so that there was ample room for an authoritative book on the subject. This was provided by Carleton Ellis in 1914, but since its publication the strides made in the oil-hardening industry have been very great, making a second edition, which endeavours to bring the subject up to date and offers suggestions of future possibilities, more than welcome.

The book has now swollen to 700 pages, and is replete with information; it is essentially a work of reference for the expert, and necessarily filled with far too much detail to be easily readable by chemists in general.

The first edition, reviewed in NATURE of May 20, 1915, deservedly established a very high reputation for the author, which will be enhanced by the new volume. Doubtless this contains the inevitable printer's errors and minor inaccuracies, but we are less concerned to seek for these than to thank the author for his unselfish labours on behalf of his future readers.

The plan followed is first to discuss the methods of hydrogenation in detail, much of the plant being illustrated and full account taken of the patent literature. The next section, occupying more than 150 pages, is devoted to the many aspects of the subject of the activity of the base metals as catalysers. The vexed question as to whether metallic nickel or nickel oxide is the active agent is fully discussed in so far that the opinions and experiments of the protagonists are given at length, but the author refrains here, as elsewhere in the book, from giving the reader any lead as to which theory is the more probable. There follows an important chapter on the analytical constants of hydrogenated oils.

Although first introduced for providing hard fats for soap-making, hydrogenation has proved equally applicable to edible oils. As fats naturally fetch a higher price as foodstuffs than as soap-making materials, their technical production in the edible form has been extensively studied. Reference is made to other uses and properties of hardened oils.

The hardening process has also been extended to petroleum, where many new problems arise, which are now described. Not only does crude petroleum contain unsaturated constituents, but these are also formed in some quantity during the cracking processes.

The first stage in any hardening process is the production of hydrogen of the necessary purity and cheapness. A variety of methods for making hydrogen are in practical operation, and still more have been suggested, so that it is not surprising that fully a quarter of the book is devoted to the description of these. In the future the cheap production of hydrogen will play a great part in the formation of ammonia from the air, and through ammonia of nitrates, and so influence increased soil fertility.

The fat-hardening industry has had more than its share of patent litigation, famous cases having been fought both in this country and more recently in America. The report of the English case is given, substantially as published in the British official journal, in an appendix, whilst the case of The Procter and Gamble Co. *v.* The Berlin Mills Co. is reprinted in such detail as to occupy eighty pages. E. F. A.

POLITICAL SCIENCE.

A New Chapter in the Science of Government. By Benchara Branford. Pp. xlviii+190. (London: Chatto and Windus, 1919.) Price 5*s*. net.

THIS book is not perhaps likely to become popular. It is defective both in shape and in style; nor is the language of the author free from eccentricity and even ambiguity. It is possible that some reason may be urged for such phrases as "Britamerindian Commonweal" or "Britamerindian re-orientation of politics," in which the author seems to take an especial pleasure. But phrases like "a spiritual instrument of exploration on the rough politico-economic *terra incognita*," or "feeling of communitary responsibility," or "an extension of our synoptical cate-

gories," or "a synoptical survey of the grand human bi-directional spiral," are disturbing, and may well be forbidding, to general readers.

Still, Mr. Branford takes a clear and strong view upon certain points which vitally concern the theory of government. Nothing can be better than the passage in which he defines the guiding spirit of the new era (p. 143). It is almost too late to advocate now the rights of women; for womanhood has already entered upon its political heritage; but he rightly bases the enfranchisement of women upon their interest, which is at least equal to men's, in the good order of the State (p. 28). Mr. Branford will carry the assent of all wise thinkers in proposing "to drop the rootedly false distinction between manual work and brain work," a distinction which "has worked so fatally and so long against the humanisation of all labour, against its higher productivity, and against the social solidarity and happiness of mankind" (p. 100). All that he says about Labour is worthy of serious regard. It is only right, too, to express an acknowledgment of the passages (for example, on pp. 79 and 80) in which he defines the successive relations between the family and the city, the region, the nation, the State, and humanity as a whole.

But when the book is judged in the light of its title, as "a new chapter in the science of government," it cannot be said that Mr. Branford's positive reforms are altogether convincing. The most original of them seems to be an inference which he draws from the "warp and weft," as he calls them, of society, *i.e.* the geographical or regional and the occupational or industrial divisions of mankind. He sees clearly that, so long as mankind is distributed geographically into countries or nations, and into these alone, patriotism itself must be exposed, as it was in Germany, to the danger of assuming a selfish, violent, and aggressive character. He finds, or hopes to find, a counter-balancing force in the various occupations of mankind. Thus if all Englishmen are naturally united in the cause of England, the miners or the railwaymen, not in England alone, but all the world over, may be united in support of their own industry. There will then be an international or cosmopolitan sense balancing the local patriotic sense of particular countries. This is, or was in the days before the war, the idea of the Labour Party; but when the war broke out, even the Socialists in Germany suffered their vocational or occupational feeling to be merged in their patriotism; and so it remained, at least until the scales of victory began to incline against the German Empire.

Mr. Branford looks forward to a "Grand Council of Humanity," which he conceives as "a world-bicameral legislature," containing, after the manner of the British Constitution, two Chambers, the Lower being geographical and the Upper occupational; and it is through this Grand Council that he hopes to attain the solution of the political, social, and industrial problems which are now dislocating the civilised world. Upon the whole, if Mr. Branford cannot be said to have made a solid contribution to political science, he has thrown out a good many suggestive ideas which may well bear fruit in the political history of the new-born age. J. E. C. WELLDON.

AMERICAN BOOKS ON AGRICULTURE.

(1) *Productive Agriculture.* By Prof. John H. Gehrs. Pp. xii+436. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 5*s.* 6*d.* net.

(2) *Farm Concrete.* By K. J. T. Ekblaw. Pp. xi+295. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 8*s.* 6*d.* net.

(3) *Peach-growing.* By H. P. Gould. (The Rural Science Series.) Pp. xxi+426+xxxii plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 10*s.* 6*d.* net.

(1) FROM the house of the Macmillan Co., of New York, there issues a constant flow of good agricultural books, and it is gratifying to find that the three now to hand are fully equal to some of their predecessors.

The first book, by Prof. J. H. Gehrs, of the Warrensburg State Normal School of Montana, is written for school children of the upper classes who propose to take up farming as the business of their life. It is frankly vocational: "this is not primarily a book *about* agriculture, but one *on* 'Productive Agriculture.' . . . Unless this book helps to increase the average yields, improve stock, make for better and more fruit, and promote better farm management, it will have failed of the purpose for which it was written."

It may at once be stated that the book deserves to achieve success. The subject-matter is very interesting; the book is full of bits of old country-lore that always make a strong appeal to the country child and the countryman, and the information so far as we can see is sound. Under the heading "Wheat," for instance, the author gives a chart showing the production in bushels of the more important wheat countries of the world with the percentage that each contributes to the world's total. This brings out in striking manner the fact that Europe normally con-

tributes 51·4 per cent. of the world's wheat—a sufficient explanation of the present scarcity. North America contributes only 27·6 per cent.—little more than European Russia. A chart is then given to show the production in certain of the States. North Dakota and Kansas easily come first, followed by Nebraska, Minnesota, Washington, etc. In yield per acre it is gratifying to note that Great Britain stands first with 33·4 bushels, followed by Germany with 30·7, France with 20·1, and the United States with 15 bushels. The cost of production per bushel is stated to be lower in Great Britain than elsewhere; but to this English farmers might not agree. The low position of the United States is not to the author's liking: "Why European countries produce larger yields an acre than the United States is an important question for study. Our natural resources are ordinarily as great as those of European countries."

America scores, however, in the efficiency of the farm labourers and the use of machinery. The portrait of Cyrus H. McCormick, who devised the modern reaper and thus revolutionised the growth of wheat, occupies a prominent place in the book, and much space is rightly devoted to machinery. A table is introduced showing how the time required of man labour to produce and thresh a bushel of wheat has fallen since 1832 from $3\frac{1}{2}$ hours to 10 minutes only, and the cost of the labour has fallen from $17\frac{3}{4}$ cents to $3\frac{1}{3}$ cents. Maize naturally claims a good deal of attention as the most important farm crop in the States in respect both of money value and of food value. The United States contributes no less than 78 per cent. of the world's supply; Iowa and Illinois are the largest producers, but Indiana, Nebraska, Missouri, and Ohio grow large amounts; these and Kansas constitute the famous "corn belt" of the States. Of oats, as of wheat, Europe is the chief producer, growing no less than 61·2 per cent. of the world's total; but in point of yield Germany comes first with 57·4 bushels, followed by the United Kingdom with 44·7, France with 30, and the United States with 29·4 bushels. Later chapters deal with animals; the style is equally good, and the matter equally interesting; a brief history of the principal breeds of live stock is given, with descriptions of their characteristics, valuable features, and methods of treatment. Next come sections on the soil, laying special stress on physical properties, then sections on fertilisers, and finally chapters on choosing a farm.

Altogether the book is one of the most successful for its purpose we have yet seen, and we imagine it will make a vivid appeal to the American students for whom it is written.

(2) The other two books are more specialised. Mr. Ekblaw writes about farm concrete, a subject of which we are likely to hear much more in this country in the future, for the making of concrete requires only sand, cement, and gravel (or similar substances); it can be moulded to almost any shape and adapted to almost any farm building purpose. The author deals with natural cement, made by calcining and then pulverising natural argillaceous limestone without preliminary mixing and grinding; and Portland cement or artificial cement, made by mixing finely ground argillaceous and calcareous materials in proportions approximately of three parts of calcium carbonate to one of silica, alumina, and iron oxide, then calcining and finely pulverising. Portland cement, it is interesting to note, was invented by an Englishman, Joseph Aspdin, in 1824, and for many years we led the way in its manufacture; but now the United States leads, surpassing all other countries both in manufacture and in use. Several varieties of concrete are made, but the constituents are always cement, a fine aggregate (usually sand) and a coarse aggregate (usually pebbles or broken stones), the purpose of the fine material being to save cement by filling up more closely the pore spaces; an apparatus called the voidmeter is described for estimating the amount of pore spaces of different materials. Reinforced concrete as used for buildings is concrete in which steel or other material is embedded to increase its strength. It was invented by a French gardener, Jean Monier, in 1876, and has proved very successful. Its use is still somewhat empirical, the underlying principles not being quite understood, but sufficient useful knowledge has been gained to reveal its great promise for the future.

Great stress is laid on the fire-resistant properties of concrete for building purposes. The building regulations in New York are severe; a building to be considered fireproof must withstand when fully loaded a temperature of 1700° for four hours, and then be subjected to a stream of water discharged from a $1\frac{1}{8}$-in. nozzle under a pressure of 60 lb. without failure. A number of systems of reinforced concrete have successfully passed the test.

The rest of the book is devoted to the special purposes for which concrete can be used on the farm. For building purposes it takes the place of both brick and wood; it can be used for buildings, posts, mangers, floors, yards, and the farmhouse itself. The book will be of great interest to country builders and estate agents who wish to build as cheaply and quickly as possible.

(3) The last book on the list, "Peach-growing,"

by Mr. H. P. Gould, follows the same lines as the other special crop-books of the Rural Science Series, of which Dr. L. H. Bailey is the editor. It is a worthy member of the series. Opening with an account of the history and economic position of the crop, the author proceeds to discuss the details of laying out and managing a peach orchard, the pests, and other details which the intelligent grower ought to know. References are given to bulletins of colleges and agricultural experiment stations, where further information can be gained.

HANDBOOKS OF CHEMISTRY.

(1) *Senior Practical Chemistry.* By H. W. Bausor. Pp. viii+217. (London: W. B. Clive. University Tutorial Press, Ltd., 1919.) Price 3*s.* 6*d.*

(2) *Volumetric Analysis for Students of Pharmaceutical and General Chemistry.* By Charles H. Hampshire. Second edition. Pp. 127. (London: J. and A. Churchill, 1919.) Price 5*s.* net.

(3) *The Preparation of Substances Important in Agriculture: A Laboratory Manual of Synthetic Agricultural Chemistry.* Third edition. By Prof. Charles A. Peters. Pp. vii+81. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 4*s.* net.

(4) *Salt and the Salt Industry.* By Albert F. Calvert. (Pitman's Common Commodities and Industries.) Pp. vii+151. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) Price 2*s.* 6*d.* net.

(5) *Industrial Chemistry.* By Dr. Clerk Ranken. (The People's Books.) Pp. 126. (London and Edinburgh: T. C. and E. C. Jack, Ltd.; T. Nelson and Sons, Ltd., 1919.) Price 1*s.* 3*d.*

(1) THESE small books differ from each other perhaps as widely as it is possible for five chemical books to differ, except in one matter, namely, that each author seems to be fully competent to deal with his subject. Mr. Bausor disclaims responsibility for the character of the course of work given in his "Senior Practical Chemistry," as it is designed to meet the requirements of the Senior Cambridge Local Examination in Practical Chemistry. We may be old-fashioned, but we still think that the qualitative character of things should be studied before an attempt is made to estimate their quantity. To say the least of it, it appears strange to us that a student, after having made preparations and done experiments some of which demand considerable manipulative skill, should then be instructed how to bend and cut glass tubing, and how to take small quantities of materials out of bottles by means of a spatula. But we suppose that this is a matter of the syllabus. The final section deals with qualitative analysis, but only so far as the detection of the acid and the base of a single salt.

(2) The title of Mr. Hampshire's manual sufficiently indicates its scope. This author also works to a syllabus, but one that is much more definite and restricted than in the preceding case. In order to make the volume more generally useful, the applications of methods to substances that may be of little importance to those who are not students of pharmacy are printed in smaller type. But the majority of these will be found of interest to any earnest student of analytical chemistry, and those who have to direct their work will find in these small-print examples an excellent help towards getting out of the ruts that "laboratory work" is so apt to suffer from.

(3) The three other volumes differ from the first two in that the authors are not guided by syllabuses prepared by others. Prof. Peters gives within his few pages of large type a really surprising amount of information. The substances of which the preparation on a laboratory scale is described are superphosphate, ammonium sulphate, four potassium salts, lead nitrate, lead arsenate, lime-sulphur (the product of boiling lime and sulphur together in water), copper sulphate, Paris green, Bordeaux mixture, and paraffin oil emulsions. But the book will prove far more interesting than if it consisted merely of these practical directions. The use and manner of action of each substance are referred to, or of each constituent of a mixture, and the reason for employing the mixture rather than the single active substance. The last line of the preface informs us that "a few simplified spellings have been used." We have failed entirely to find consistency in these simplifications. *Ph* is replaced by *f* in *sulphate*, but not in *phosphate*. Final *e's* are sometimes omitted, but by no means always, and the same may be said of the *e* in the final syllable *ed*. *Coold, cald, lims, eg, brot, floc, thot, enuf, thru, volum* are examples of the simplifications, while, on the other hand, the author uses *feldspar*, although in this country the *d* has been omitted for more than a generation. These peculiarities mar the book, for they cannot fail to distract attention from the main subject. A students' manual of chemistry is not the place to introduce spelling reforms.

(4) Mr. Calvert, in his monograph on "Salt," restricts himself almost entirely to the history of the Cheshire salt district and its industry. The scant treatment of this subject at the hands of authors in general is ascribed to the comparatively

small group of men engaged in the industry, and their jealousies of one another and especially of outsiders. They have endeavoured to keep their secrets as well as their profits. The author says that the story is, for the most part, a chronicle of bitter struggles to maintain a monopoly, even at the cost of ruinous losses, and the stubborn persistence in "obsolete methods." But the chapter on the "latest methods of salt-making" leads us to hope that these times are now of little more than historic interest. The book is well illustrated, showing ancient works from old prints, salt-mine interiors, subsidences of land consequent on salt mining, and the most modern apparatus.

(5) "Industrial Chemistry" is, of course, a much more extensive subject than any of the preceding. Though the price of this volume is less than half that of any of the others, it is not the smallest book, and, bound in a very presentable green cloth, it shows what is possible in book production even in these times. It is difficult to see how anyone could have got more information into the same space than Dr. Ranken has, or to find any section of this wide subject that he has passed over, and yet the volume is a true "people's book," and does not leave any impression of undue condensation. The first chapter, being headed "Catalysis and Catalysts," may tend to repel the non-technical reader, but he has only to pass over the title and all will be well. The honesty of the author is highly commendable when he says that "there are fashions in chemistry as in other lines, and the views concerning catalysis held to-day may be absolutely unfashionable to-morrow." This is true of other matters than catalysis. C. J.

FRESH-WATER BIOLOGY.

(1) *Fresh-water Biology*. By Prof. H. B. Ward and Prof. G. C. Whipple. With the collaboration of a Staff of Specialists. Pp. ix+1111. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 28*s*. net.

(2) *Aquatic Microscopy for Beginners; or, Common Objects from the Ponds and Ditches*. By Dr. A. C. Stokes. Fourth edition, revised and enlarged. Pp. ix+324. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 10*s*. 6*d*. net.

(1) PROFS. WARD AND WHIPPLE and their twenty-five collaborators have produced a volume to which students may refer for precise information upon the organisms met with in fresh water in North America. Introductory chapters deal with general biological factors and methods of collecting. Succeeding chapters, devoted respectively to single orders or classes, give a general account of the occurrence, a brief description of the anatomy (including reference to the features used in classification) and of the life-history and biological relations, and, finally, a key to the genera, and in several cases also to the principal species of the group. The information in the key about any given genus includes not only the diagnostic characters, but also in most cases an illustration and some reference to the frequency, the range, or other data; thus the whole information "forms a solid panel and appeals promptly and as a whole to the eye and mind of the student."

Much good work has been put into this book, and especial mention may be made of the excellent chapters on Turbellaria, Trematodes and Cestodes, and free-living Nematodes, the last-named noteworthy for the detailed figures. The chapters on Cladocera, Copepoda, Ostracoda, and Mollusca are provided with numerous original illustrations. In the chapter on Rotifers, Prof. H. S. Jennings has given a very useful account of the biology and structure of these animals, and a survey of the families, pointing out the various modifications from the Notommatoid type from which the author (with Wesenberg-Lund) considers the other families to have been derived.

In addition to the notes on habitat given throughout the book, here and there are short notes on points of special importance connected with the distribution. Two of these may be cited as examples. Reference is made to the finding by Prof. Garman, in September, 1916, of large numbers of the fresh-water medusa *Craspedacusta* (*Limnocodium*) *sowerbii* in a creek near Frankfort, Kentucky. This medusa, first found in 1880 in the Victoria Regia tank in the Botanic Gardens in Regent's Park, and afterwards in tanks in other gardens in Europe and America, is now recorded for the first time from other than artificial surroundings. Dr. Ortmann, in a short note under *Mysis relicta*, states that, so far as the North American stock of this species is concerned, there is no reason to assume that it is a marine relic; it may be regarded as an immigrant into the Great Lakes in Glacial times.

This excellent treatise should greatly stimulate the study of the fresh-water fauna of North America, and will be very helpful for comparative purposes also to workers in this country.

(2) The author, who modestly styles himself "only a beginner" writing for beginners, has given his descriptions of the microscope and its parts and of aquatic organisms in language as

little technical as possible. The biology and some elementary points of structure of each group are briefly considered, and useful keys are provided to aid the reader in finding at least the generic name of the more common organisms which the author has collected from a single pond in New Jersey. Special attention has been devoted to certain groups—*e.g.* Gastrotricha, Rotifera, Polyzoa. Here and there the desire to be non-technical in terminology has been carried a little too far—*e.g.* the egg-masses of Cyclops should not be called "external ovaries," and the term "contractile vesicle" is not a good substitute for "contractile vacuole"—the latter term could have been quite easily defined. Helpful illustrations (198) as aids in diagnosis of the genera are given, but we would suggest that when the book reaches a fifth edition figures should be added of some of the commoner transparent animals, *e.g.* a rotifer, a polyzoon, Daphnia, in which the chief internal organs are clearly shown and labelled.

OUR BOOKSHELF.

The Elements of Astronomy for Surveyors. By Prof. R. W. Chapman. Pp. x+248. (London: C. Griffin and Co., Ltd., 1919.) Price 5*s.* net.

SIR JOHN HERSCHEL'S dictum in his well-known panegyric on star-catalogues, that "every well-determined star from the moment its place is registered is as effective for mapping down the intricacies of a petty barony as for adjusting the boundaries of transatlantic empires," may be taken as the *raison d'être* of this book. The author is professor of mathematics and mechanics in the University of Adelaide, and doubtless the southern continent gives scope for surveying on a large scale in which astronomical observation is a necessity.

The book is on conventional lines, the first six chapters dealing with the elements of geometrical astronomy, including one which explains at some length with examples the conversion of sidereal into mean time and similar arithmetical processes. The latter half of the book consists of chapters on the determination of true meridian, on azimuth of a mark, of latitude, time, and longitude. Most of the recognised methods are concisely explained, and illustrated in some cases by examples taken from actual experience. Use is made of the observation of circumpolar stars at elongation for determination of azimuth, and for time the observation of altitude of the sun or a star near the prime vertical is recommended and discussed in full detail. The inclusion of a few pages on the almucantar is a useful addition to the book, which will fulfil its intended purpose of providing an elementary exposition of the principles of the formulæ used by the surveyor.

Organic Chemistry for Students of Medicine. By Prof. James Walker. Second edition. Pp. xi+332. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1919.) Price 10*s.* 6*d.* net.

THIS second edition of Prof. Walker's book for medical students does not differ substantially from the first edition as issued in 1913. It may, however, be useful to direct the attention of medical students and their teachers to a volume which has been written specially to suit their requirements, and the value of which is shown by the publication of a further issue.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Promotion of a Plumage Bill.

ALL lovers of animals must sympathise with any efforts to prevent the ruthless destruction of bird-life for trade purposes, referred to by Mr. H. J. Massingham in his letter in NATURE of December 25. It is open to grave doubt, however, whether the measures announced are the best that can be devised or will meet with a sympathetic following. They are the formation of a "Plumage Bill group," designed to fight the plumage trade and to bring pressure upon the Government to introduce a Bill forbidding the importation of all birds' skins for millinery purposes, with a few exceptions.

From time immemorial plumage has been employed to satisfy the decorative and æsthetic instincts of mankind, though to-day public opinion is rightly determined that it must be procured under conditions conforming with our humane sentiments. We may well inquire, therefore, whether the æsthetic demands for plumage can be met without outraging these. The ostrich in South Africa supplies a forcible case in point. In times past the wild bird was hunted for its precious plumes, and would have become almost extinct ere this had not its domestication been undertaken. As it is, the wild bird is now preserved and is increasing in numbers, and hundreds of thousands of domesticated birds lead a pampered existence on the ostrich farms. A big industry has arisen of the highest importance to agricultural South Africa, representing in pre-war days an annual export value of about 3,000,000*l.*

It is submitted that what has been accomplished with the ostrich may be possible with other birds supplying ornamental plumage; that, like it, others may give rise to industries and yield their plumage in conformity with the highest humane demands. One ventures to suggest that, instead of pursuing a repressive policy, the efforts of Mr. Massingham and his associates would be better directed in instituting studies and investigations as to conditions under which plumage-birds could be reared on an industrial basis.

Mr. Massingham appears to have an unworthy view of the issues involved in his announcement, for in the plumage trade he sees "no other purpose than to feed the profits of a small band of East End traders and to satisfy the frivolity of some women." Though ostrich plumes are exempted from the operations of the proposed Bill, yet so sensitive is the inter-relationship

between plumage of all kinds that when the Anti-Plumage Bill was introduced in 1913 the trade insecurity engendered was so far-reaching as to constitute one of the principal causes of the serious slump in the South African ostrich industry, involving the loss of millions of pounds—a slump from which, the war supervening, the Union is only slowly recovering. The introduction of another Bill would be viewed with alarm in South Africa, and would have a serious international bearing, particularly upon our Ally, France, involving thousands of workers and millions of capital. It surely were wise not to attempt it when other measures are possible which would afford a wide stimulus to industry and to the study of bird-life.

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Musical Drums with Harmonic Overtones.

IT is well known that percussion instruments as a class give inharmonic overtones, and are thus musically defective. We find on investigation that a special type of musical drum which has long been known and used in India forms a very remarkable exception to the foregoing rule, as it gives harmonic overtones having the same relation of pitch to the fundamental tone as in stringed instruments. Five such harmonics (inclusive of the fundamental tone) can be elicited from the drumhead in this type of instrument, the first, second, and third harmonics being specially well sustained in intensity and giving a fine musical effect. The special method of construction of the drumhead which secures this result will be understood from the accompanying illustration (Fig. 1). It will

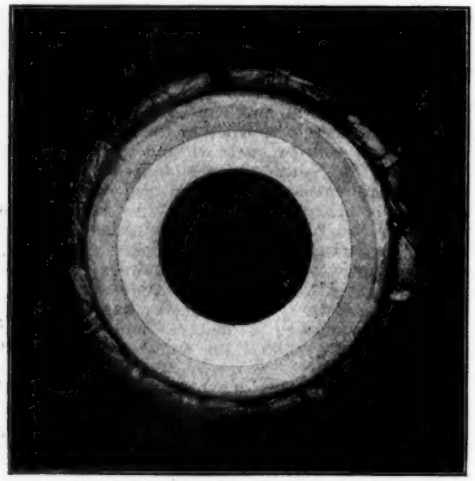

FIG. 1.—Drumhead giving harmonic overtones.

be noticed (1) that the drumhead carries a symmetrical distributed load, decreasing in superficial density from the centre outwards (this appears as a dark circle in the middle of the membrane, the load consisting of a firmly adherent but flexible composition, in which the principal constituent is finely divided metallic iron); and (2) that a second membrane in the form of a ring is superimposed on the circular membrane round its margin.

The character of the vibrations of this heterogeneous membrane which give rise to its remarkable acoustic properties have been investigated by us. It is found, as might have been expected, that the fundamental pitch and the octave are derived respectively from the modes of vibration of the membrane without any nodal lines and with one nodal diameter. The third harmonic, we find, owes its origin to the fact that the next two higher modes of vibration of the drumhead (those with two nodal diameters and with one nodal circle respectively) have identical pitch, this being a twelfth above the fundamental. There is reason to believe that the fourth and fifth harmonics similarly arise from some of the numerous more complex modes of vibration of the drumhead becoming unified in pitch in consequence of the distributed load at the centre and round the periphery of the membrane. The central load also improves the musical effect by increasing the energy of vibration, and thus prolonging the duration of the tones.

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SIVAKALI KUMAR.

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December 10.

Power from the Sun.

MR. A. A. CAMPBELL SWINTON, in his letter on the above subject in NATURE of December 18, states that "it is hopeless to expect to be able to effect anything of this nature with the heat-engine, for with this we should scarcely reach the 2 per cent. efficiency nearly attained by vegetation."

For nearly four years immediately preceding the war I was engaged by the Sun Power Co. (Eastern Hemisphere), Ltd., and the Shuman Engine Syndicate, Ltd., on the problem of the utilisation of solar energy, upon which these companies spent a considerable sum of money, the experiments being conducted on a large scale in America and Egypt, while the trials of the necessary low-pressure engine (which made an easy record for such engines) were made in this country. The results of the whole of this work are recorded in my two papers both bearing the title "The Utilisation of Solar Energy," one being read before the Society of Engineers in April, 1914, and the other before the Royal Society of Arts in April, 1915.

At p. 540 of the Journal of the Royal Society of Arts of April 30, 1915, it was shown that the overall thermal efficiency of the sun power plant erected in Egypt was 4·32 per cent., which is to be compared with the performance of the best steam-engine and boiler of 11·5 per cent. At p. 560, *ibid.*, it was shown that the theoretical efficiency of an engine working between the same limits of temperature would be 5·9 per cent., and that, consequently, the relative efficiency of the sun power plant to this ideal engine was no less than 73·2 per cent. From this it will be seen that Mr. Campbell Swinton's estimate of the thermal efficiency of 2 per cent. for a sun-power steam plant is more than 100 per cent. too low.

It is well that any wrong impression which the lower figure might give should be corrected, for in these days of extremely expensive coal it is desirable that inventors, experimenters, and financiers should not be discouraged from attempting to utilise solar energy, which some of us think is bound to be realised in the future. In the Royal Society of Arts paper it was shown that the cost of solar energy was equivalent to coal at 3*l.* 10*s.* a ton, and from this it is obvious that had the companies had more time in which to develop and construct plants before the war, they would have been paying handsomely, with coal at its present prices, in Egypt, Chile, and other sun-bathed countries.

ALFRED S. E. ACKERMANN.

25 Victoria Street, Westminster, S.W.1,
January 6.

TRIODE VALVES AS ELECTRIC AMPLIFIERS.

AMONG the most exquisite tools that modern wireless telegraphy now proffers to investigators working in the fields of pure science, that known as the amplifier stands out as being of the most obvious promise in various directions. The amplifier offers the means of magnifying varying electro-motive forces and currents, otherwise imperceptible, so that they come within the range of ordinary laboratory measuring and recording instruments. It was developed during the war to a high pitch of excellence, not only for the improvement of wireless telegraph signals, but also for other kinds of signalling and for listening under water and under the ground—that is to say, it has been fully developed for the magnification of the high-frequency currents used in wireless telegraphy and for currents of telephonic frequency. Descriptions of the apparatus have now been published in many places, and the tool as thus developed will in due course take its place in the laboratory. For many purposes, however, an amplifier that will faithfully magnify slow variations of a current or electro-motive force is demanded, and since little has been published about such apparatus, the following notes of methods used in the writer's laboratory during the past few years are now presented.

As the term is usually understood nowadays, an amplifier consists of one or more of the three-electrode thermionic vacuum valves of wireless telegraphy associated with auxiliary transformers or analogous apparatus. This particular kind of valve may for brevity be called a triode valve, or even a triode. It comprises a hot filament for supplying electrons, which serves as cathode, a plate, or cylinder, which serves as anode, and an intervening grid, all contained in a highly evacuated bulb. The bulbs generally used in amplifiers are about the same size as the common incandescent filament lamp, but the filament cathode of the triode is proportioned so as to become white hot when a battery of about 5 volts is joined to its terminals to supply about three-quarters of an ampere of current. A battery of, say, 50 volts, connected with its positive pole to the anode and its negative pole to the cathode, causes a current of order one milliampere to flow when the grid is at the same electric potential as the mid-point of the filament, and of perhaps twice this value when the grid is given a potential one volt higher.

The reason for this influence of the grid may be briefly explained as follows: When, in obedience to the electro-motive force applied between anode and filament, an electron current flows from the filament, the distributed electric charge in the space creates an electric field that tends to repel electrons back to the filament, or, in other words, gives rise to a back electro-motive force acting against the battery. But making the grid positive relative to the filament partially neutralises the field of the space charge, and therefore reduces the back electro-motive force. This influence is greater the closer the mesh of the grid; in some commercial triodes one volt on the grid will cancel ten volts of the back electro-motive force, or, in other words, one volt applied to the grid is worth ten volts applied in the anode circuit. At the same time, the current flowing on to the grid when one volt is applied between grid and filament is, perhaps, only a microampere; the multiplication of current performed by the triode is thus a thousandfold. Moreover, since the energy input to the grid is, in the assumed circumstances, 1×10^{-6} watt, and the consequent additional energy output of the high-voltage battery in the anode circuit 50×10^{-3} watt, the energy ratio is 50,000. Not all this output is available for use, however; we may, in fact, scarcely hope to use half of it.

It is worth while emphasising here a difference between an electro-magnetic transformer and a triode regarded as a transformer. The transformer may be arranged to give in its secondary circuit a voltage many times that applied to the primary, but the current is correspondingly diminished to keep the output of the energy equal to the input (losses being neglected). But in the case of the triode valve the current, as well as the electro-motive force, is multiplied, and the consequently multiplied energy output takes place at the expense of the high-voltage battery.

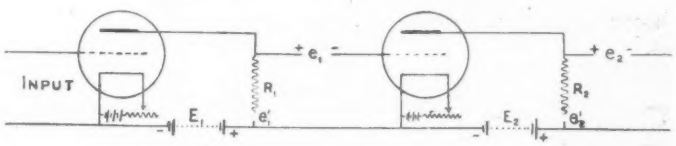

FIG. 1.

The most highly developed type of amplifier is that intended for the magnification of currents alternating more than 100 times per second, and consists of a number of triode valves linked in tandem by means of the mutual inductance of transformers. The earliest instruments were probably constructed by de Forest. Excellent instruments can now be made for any frequency between 100 and 1,000,000. It is stated that Mr. H. J. Round, of the Marconi Co., has used up to twenty-two triodes in tandem, and obtained magnifications of potential difference of about half-a-million-fold. As already stated, amplifiers for rapidly alternating current have been described elsewhere, and are not the subject of this article.

The type of amplifier described in Fig. 1 may be used for magnifying currents that vary slowly. It appears to have been conceived first in the French Military Radio-telegraphic Laboratory in Paris. In this apparatus the linkage between successive triode valves is accomplished by means

of resistances and batteries. Considering the anode circuit of the first bulb, we see that it contains a resistance R_1 and a high-voltage battery E_1. Let $E_1=80$ volts, $R_1=30{,}000$ ohms, and the current be 1 milliampere. At present ignore the batteries marked e_1, e_1'; then the fall of potential along R_1 is $30{,}000\times10^{-3}=30$ volts. Such a potential difference applied between the grid and filament of the second triode would put this tube completely out of action. It is therefore necessary to introduce a neutralising battery of about 30 volts at the point marked e_1, or at the point marked e_1'. In the latter case the battery will, in fact, be a portion of the battery E. Suppose

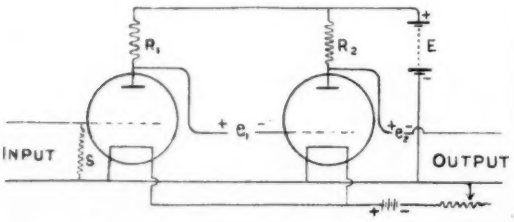

FIG. 2

this to be done, and imagine an electro-motive force e_g to be applied between the input terminals of the amplifier. Then it can be shown that the consequent increase of current in the anode circuit is

$$\frac{ge_g}{R_1+1/h_a},$$

where g is the triode's voltage factor, and h_a its differential conductance. These parameters are frequently of the order

$$g=10 \text{ and } h_a=10^{-4}.$$

The electro-motive force handed on to the second triode from the terminals of R_1 is clearly of magnitude

$$\frac{R_1ge_g}{R_1+1/h_a}.$$

Using the value of R_1 suggested above, we find that the multiplier of e_g becomes

$$\frac{30\times10^3\times10}{40\times10^3}=7{\cdot}5.$$

The amplification approaches the limit 10 (that is, the value of g) the greater we take the value of R_1; but obvious practical reasons limit the magnitude of this resistance.

This type of amplifier, usually spoken of as a resistance cascade amplifier, has been much used by the Americans and the French for amplifying rapidly varying currents, but in that case a condenser is substituted for the battery at e_1; a "grid leak" of order a megohm must then be connected between grid and filament in each triode in order to avoid the accumulation of negative electricity on the now insulated grid. The complete instrument is then usually connected so as to utilise a common battery of 4 or 6 volts for all filaments, and a common battery of about 80 volts for all anodes. Adopting common battery connections, a finished two-stage amplifier is seen in Fig. 2. The grid leak S connected between the first grid and its filament might be about a megohm, and is necessary only when the circuits from which the input to the amplifier comes are such as would otherwise leave the grid insulated. According to the computations given above for one stage, the amplification with this two-stage instrument should be

$$7{\cdot}5\times7{\cdot}5=56\text{-fold}.$$

Finally, a mode of connection due to the present writer may be described. It is shown in Fig. 3, arranged to constitute a two-stage amplifier suitable for use with slowly varying currents. The first triode of the pair has resistances Q_1, R_1, S_1, connected so as to constitute with the bulb the four arms of a balanced Wheatstone bridge. The high-voltage battery E_1 is connected across two opposite corners of the bridge. An electrical stimulus applied to the grid causes the balance to be disturbed, and a corresponding potential difference arises between the filament lead and the junction of Q_1 and R_1. This difference of potential is conveyed to the next triode by direct connections. The magnification is the same as that obtained with the arrangement of Fig. 2 when resistances S_1, S_2 are taken of the same value as R_1 in that figure. A grid leak S is used when necessary, for the reason explained before.

In conclusion, it would be well to point out that in deciding upon the resistances and the voltages to be employed in constructing these amplifiers, the characteristics of the triodes should be kept in mind with the view of using them all at such adjustments that the relation between input and output potential differences is linear, and the magnification therefore free from distortion.

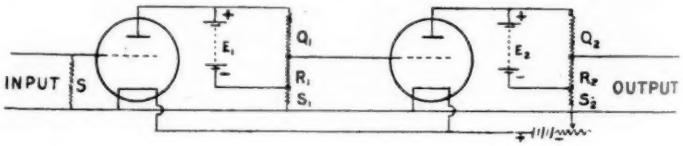

FIG. 3.

W. H. ECCLES.

INDIAN GEOLOGY.[1]

THE appearance of a manual of Indian geology of so excellent a character as the present work, written by an Indian geologist, is an event of some importance, since it furnishes a fresh and convincing answer to the argument so often

[1] "Geology of India for Students. By D. N. Wadia. Pp. xx+398+xx plates. (London: Macmillan and Co. Ltd., 1919. Price 18s. net.

put forward that the Oriental mind, though it may assimilate the ideas of Western science with ease, is yet incapable of applying the principles of that science to original research. It is true that the author in his preface modestly admits that the book is in the main a compilation; yet the able manner in which he has marshalled the facts, and the clearness of his reasoning, especially when dealing with matters that are still open to controversy, show that he is by no means lacking in originality of thought and expression.

As a text-book for the use of the elementary student, perhaps, the work is not all that is required. There is still room for a book which would lead the student gradually to a knowledge of the science, by illustrations drawn from the rich field of observation that lies open to him in India itself. No systematic attempt is made to explain the meaning of geological terms, and the book presupposes a knowledge of the subject which the average student certainly would not possess. To the advanced student, in the sense that every scientific man is a student throughout his life, the book must prove extremely useful.

There are many pitfalls awaiting the student who fails to profit by the pertinent advice (p. 41) "not to commit the mistake of merely trying to memorise the dry summary of facts regarding the 'rocks' or 'fossils' of a system, or consider that the idea of a geological system is confined to these. These are the dry bones of the science; they must be clothed with flesh and blood by comparing the processes and actions which prevailed when they were formed with those which are taking place before our eyes in the world of to-day. A sand-grain or a pebble of the rocks is not a mere particle of inanimate matter, but is a *word* or *phrase* in the history of the earth, and has much to tell of a long chain of natural operations which were concerned in its formation. Similarly, a fossil shell is not a mere chance relic of an animal that once lived, but a valuable *document* whose preservation is to be reckoned an important event in the history of the earth. . . ." (The whole passage is too long to quote, but it furnishes a good example of the author's style.) In the making of tables of rock-sequence and correlation it is impossible to avoid what appear to be definite statements regarding a formation the position of which may be doubtful; and when the student merely learns these tables by heart for examination purposes (a practice which too often defines the limits of the candidate's knowledge of the subject), he is apt, having missed the qualifying explanation given in the text, to unload his modicum of knowledge with results disastrous to himself. Thus, in the general table of formations (p. 47), the rocks of the Simla area, from the Blaini boulder bed upwards, are boldly correlated with the Vindhyans of the peninsula,

FIG. 1.—Bellary Granite-Gneiss Country, Hampi. From "Geology of India for Students."

though it has not yet been proved that this boulder bed is not the equivalent in age of the Carboniferous Talchers. The Simla and Jaunsar slates, the Dalings of Sikkim, and the Shillong quartzites in Assam are all correlated with the Dharwars of Southern India, and, probable as these correlations may be, even as regards lithological resemblance there is little in common between these formations and the highly altered schists and jaspers of the typical Dharwars. Again, in the table giving the Cambrian succession of the Punjab Salt Range, the salt marl is placed at the base of that system, though it has recently been shown that there is good reason to believe this peculiar formation to be of Tertiary age.

Dharwars, which would make them the oldest rocks of the Peninsula (p. 69). Insistence is laid (pp. 135, 150) upon the importance of the stratigraphical break at the close of the Carboniferous period, which separates the Dravidian and Aryan groups of Sir T. Holland's classification of the Indian geological sequence. Full attention is also given to the recent discovery in Kashmir of beds containing the characteristic flora of the Talcher series, associated with marine strata, thus fixing a base limit for the Gondwana system, and closing a long-standing controversy.

A useful chapter on "Economic Geology" closes this part of the work, and then follows a special chapter on the geology of Kashmir, where,

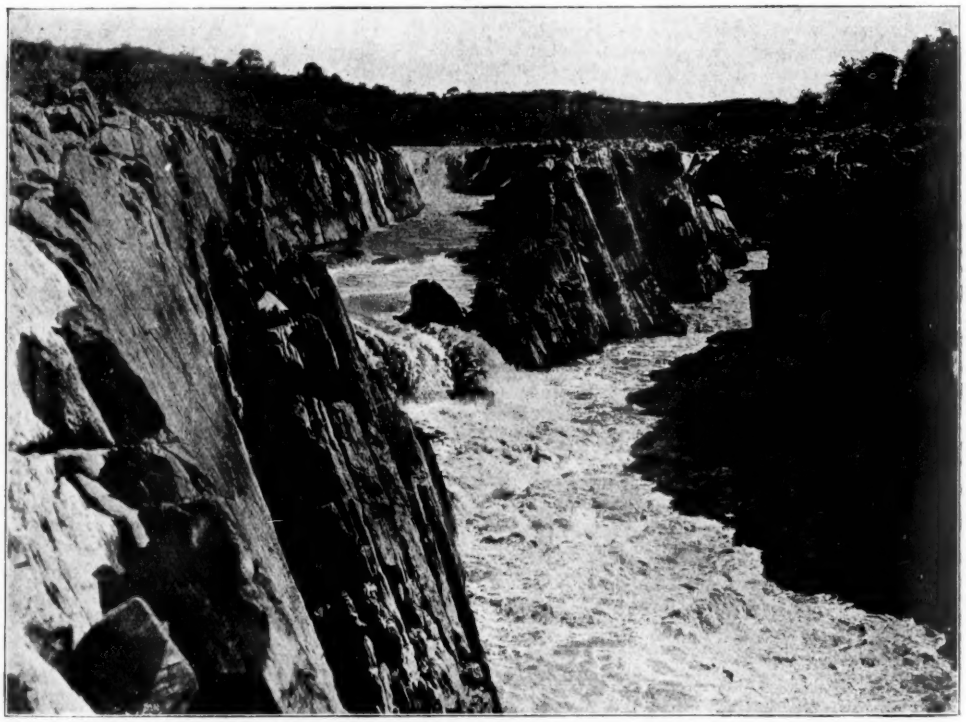

FIG. 2.—"Marble Rocks" (Dolomite marble), Jabalpur. From "Geology of India for Students."

The arrangement of the book follows the usual lines. The physical features, mountains, glaciers, etc., are each briefly dealt with in the opening chapter. (Some of these are again described in a chapter on "Physiography" towards the end of the book (chap. xxv.), a somewhat peculiar arrangement, resulting in a good deal of repetition.) Then follow the various systems from Archæan to Pleistocene and Recent, the information with regard to each being carefully and clearly given in sufficient detail. Full advantage is taken of recent advances in our knowledge of Indian geology. Allusion is made to the revolutionary ideas of Dr. Smeeth and his band of workers in Mysore concerning the age of the

as the author remarks, "within a small geographical compass one of the finest developments of the stratified record seen in the Indian region and perhaps in the world" is revealed, in a situation more accessible to the student than any other in the whole length of the Himalaya. It may here be remarked that much remains to be done before the geology of this fascinating country is worked out in detail.

The book is written in clear and good English, and is well got up. Very few typographical errors have been noticed, but among them may be mentioned "Jena," presumably for "Jura" of Spiti (p. 165); "corrosion" for "corrasion" (p. 277); and twice (pp. 198, 200) "*Physa princepii*" for *Physa*

typical fossil of the intertrappean beds of the Deccan, named in honour of the well-known secretary of the Asiatic Society of Bengal, James Prinsep. Numerous photographic views, diagrams, and maps add to the interest of the work, most of which are taken with due acknowledgment from the publications of the Geological Survey of India. Of the author's own views, two have been selected for reproduction, one showing a typical landscape in the crystalline area of the peninsula, and the other that unique feature in one of the great peninsular rivers—the falls on the Narbada, near Jabalpur. T. H. D. L.

METEOROLOGY IN THREE DIMENSIONS.[1]

IN 1916 Mr. W. H. Dines put together in a concise report the information then available about the pressure, temperature, and density of the atmosphere up to heights of 15–20 kilometres. His report is now published, and should prove extremely useful and informing both to the new generation of meteorologists and to the wider circle whose interest in the atmosphere is non-professional.

The first nine sections deal with the methods and places of observation, the averages and seasonal variations of pressure, temperature, and density, and the stratosphere and troposphere; short accounts of humidity and atmospheric motion are also included.

The tenth and eleventh sections are concerned with the results of the statistical treatment of the original data; the interpretation of these results will provoke much discussion. First, the correlation coefficient between (1) the mean temperature of a vertical column extending from a height of 1 km. to a height of 9 km. and (2) the pressure at the *top* of the column is 0·95. The hydrostatic equation connecting variations of pressure at 1 km. and 9 km. with variations of the mean temperature of the column of air is

$$\frac{\delta p_9}{p_9} = \frac{\delta p_1}{p_1} + \frac{k\delta T}{T^2}.$$

From this it follows that if $\frac{\delta p_1}{p_1}$ is (1) zero or (2) proportional to $\frac{\delta p_9}{p_9}$, then the correlation coefficient between p_9 and T is unity.

The first condition is not fulfilled in temperate latitudes; the second condition would be satisfied if the isobars at 9 km. were parallel to those at 1 km.—*i.e.* if the wind-directions at these levels were identical. But in the troposphere convection is always tending to make the direction of the wind the same at all levels, so that the magnitude of the correlation coefficient found by Mr. Dines may be due to the effectiveness of convection in regulating the wind. It would be interesting to know the differences from parallelism permitted by the 0·05 by which the actual coefficient falls short of unity.

Secondly, if T_0, P_0; T_1, P_1, etc., are the temperatures and pressures at heights of 0, 1, 2, . . 13 kilometres, then the correlation coefficients between corresponding T's and P's, beginning with T_0, P_0, are as follows: ·11, ·42, ·66, ·77, ·84, ·85, ·86, ·86, ·86, ·71, ·32, −·19, −·36, −·28. It follows that pressure and temperature go up and down together with great regularity at all heights between 3 km. and 9 km. Presumably the same would hold for the surface were it not for the effects of radiation and of the surface water of the ocean upon the surface temperature of the air.

Two outstanding deficiencies in the information available call for comment. There are no records from the United States, India, Australia, South Africa, South America, and Japan. This is no doubt partly due to the difficulties of recovering records in these countries if the ordinary European method of investigation is used; but it is also due to the defects of pre-war international meteorological organisation in which no place was found for an active permanent bureau. Further, the information about atmospheric motion is hopelessly inadequate. This arises less from lack of original records than from the absence of any proper arrangements for summarising the results of pilot-balloon ascents. A young meteorologist seeking a field of independent research might do worse than turn to the statistical treatment of vectors.

Before the war the investigation of the free atmosphere was, broadly speaking, pure research; the work had no direct application in forecasting or climatology, and the means of investigation were slight and relatively expensive. During the war a knowledge of the actual conditions of the atmosphere at least up to 20,000 ft. (6 km.) became essential for heavy artillery and for aviation, and their importance for actual daily forecasting began to be dimly recognised. Now that artillery operations are over and aviation is practically restricted to low levels, there is a great risk of the investigation at higher levels by aeroplanes and kite-balloons being neglected; and instead of information being available an hour or two after it was obtained, records would again creep in months or years out of date, with no possibility of immediate practical usefulness. E. GOLD.

[1] Meteorological Office. Geophysical Memoirs, No. 13. "The Characteristics of the Free Atmosphere." (London: Meteorological Office, 1919.) Price 2s. net.

SIR THOMAS R. FRASER, F.R.S.

WHEN, in 1877, and then in his thirty-sixth year, Thomas Richard Fraser was called to succeed Sir Robert Christison as professor of materia medica in Edinburgh University, it could scarcely have been anticipated how closely he was to rival his great master in his length of tenure of the chair and in the distinction with which he was to fill it. In his varied spheres of action Fraser attained a commanding position as a physician, as an investigator, and as a professor.

Gifted with acute senses and a fearlessly logical mind, and trained in the habits of accurate observation and experiment in the laboratory, Fraser

brought to the hospital wards a rare combination of qualities. He had few equals as a diagnostician and therapeutist. As a teacher, his unswerving scientific attitude to the problems of clinical medicine had on the thousands of students who passed through his hands an influence scarcely to be overestimated. He taught not only accuracy of method, but also precision of language. His gifts as a physician were recognised by his holding, among other distinctions, the offices of physician to the King in Scotland, and of president of the College of Physicians of Edinburgh, of the Association of Physicians of Great Britain and Ireland, and of the Indian Plague Commission. He was knighted in 1902.

As an investigator, Fraser was one of the pioneers of experimental pharmacology. His greatest discoveries—from the point of view of their immediate practical application—were those which, in strophanthus and physostigmine, added to our Pharmacopœia remedies still in everyday use for the purposes for which he recommended them. For far-reaching scientific value they were even exceeded by the monograph which he wrote in collaboration with Prof. Crum Brown on the relation between chemical constitution and physiological action, embodying one of the most suggestive and fruitful researches in the history of pharmacology. For his researches he was made a laureate and Barbier prizeman of the French Academy of Sciences, and was awarded the Macdougall-Brisbane and Keith prizes of the Royal Society of Edinburgh.

Fraser combined an aptitude for both science and business. He took a keen interest in educational problems and an active part in introducing many university reforms. For twenty years he acted as dean of the faculty of medicine, and for ten years represented that faculty on the University court, and his University on the General Medical Council.

Endowed with a remarkably lucid and quick mind himself, Fraser was intolerant of mental slowness in others, sparing of praise, and at times not slow to censure. But he expected a man's best, and his standard was high. He carried himself—a keen, spare, scholarly figure—with a faint, indefinable hauteur, which may have been to many a barrier to close intimacy. But when this barrier was surmounted, and when he could lay aside the cares of too unremitting labour and of indifferent health, he would weave a grace and charm which few could resist or forget. Especially in later years he fought a continual battle with bronchitis and emphysema with a fortitude which is surely characteristic of sufferers from this condition. That he was so long permitted to lead an active life—for he retired only two years ago—was due in no small measure to the loving care and encouragement of Lady Fraser and the kindly supervision of his staunch friend and physician, Sir James Affleck.

Plummer, Gregory, Fowler, Withering, Lister, Simpson, Hughes Bennett, Christison, Brunton, Fraser—alumni or professors of the University of Edinburgh, a roll enviable and for one medical school possibly unequalled—file before us in retrospect. Their achievements in adding to our knowledge of remedies for disease and for pain stretch from the picturesque twilight of empiricism to the clear light of scientific method. With the passage of the last to that unknown bourn, we salute their memory. J. A. G.

NOTES.

A SPECIAL general meeting of the Royal Society will be held on January 22, at 3.30, to admit H.R.H. the Prince of Wales as a fellow of the society.

THE meeting of February 5 has been set apart by the council of the Royal Society as a meeting for a discussion on "The Theory of Relativity," to be opened by Mr. Jeans and continued by Prof. Eddington, the Astronomer Royal, and others.

THE International Research Council has been constituted, by successive meetings in London, Paris, and Brussels, as a Federation of National Research Unions. Under its auspices unions are being formed for the organisation of international work and co-operation in different departments of science, the unions already instituted being for astronomy, geodesy and geophysics, mathematics, and (provisionally) chemistry and biology. The question of international organisation in science is raised, to a great extent, by Article 282 of the Peace Treaty, which states that "treaties, conventions, and agreements of an economic and technical character not included in a specified list cease to be operative." That this article was intended to cover conventions on scientific matters appears from the list of exceptions, in which the Metric Convention and the International Agricultural Institute at Rome are included.

WITH the view of obtaining the opinion of representatives of pure and applied science upon the subject of the co-ordination of international effort and action, a special meeting of the Conjoint Board of Scientific Societies was held at the Royal Society on January 8. After much discussion the following resolutions were passed:—"(1) That the executive committee be requested to appoint committees for the purpose of considering the desirability of forming in branches of science, as recommended by the Brussels Conference, international unions connected with the International Research Council, or of joining such Unions if formed independently. (2) That these committees be authorised to make recommendations with regard to the proposed statutes and the constitution of national research councils. (3) That the committees consist of representatives nominated by the principal societies concerned, together with additional members nominated by the executive committee."

WE regret to see the announcement of the death on January 11, at seventy-three years of age, of Father J. N. Strassmaier, the distinguished Assyriologist, whose work with Father Epping on Assyrian astronomy is well known.

THE Scientific Instrument, Glassware, and Potash Production Section of the Board of Trade has been transferred from 7 Seamore Place, W.1, to the main offices at Great George Street, S.W.1.

THE council of the Geological Society of London has this year made the following awards:—Wollaston medal, Prof. Baron Gerard Jakob de Geer (Stockholm); Murchison medal, Mrs. (Dr.) E. M. Shakespear; Lyell medal, Mr. E. Greenly; Wollaston fund, Mr. W. B. R. King; Murchison fund, Dr. D. Woolacott; and Lyell fund, Dr. J. D. Falconer and Mr. E. S. Pinfold.

THE Secretary of the Department of Scientific and Industrial Research announces that the Research Association for the British Launderers' Industry has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. As the Association is to be registered as a non-profit-sharing company, the promoters have applied to the Board of Trade for the issue of a licence under section 20 of the Companies (Consolidation) Act of 1908. The secretary of the committee engaged in the establishment of this Association is Mr. J. J. Stark, 162–165 Bank Chambers, 329 High Holborn, W.C.2.

WITH the approach of a return to normal conditions, the Natural History Museum, we are glad to learn, is developing a policy of adding to the national collections by means of exploration. Thus Mr. Willoughby Lowe, who has already made several expeditions to Africa on behalf of the museum, has recently started on a mission to the West Coast of Africa for the purpose of collecting specimens for South Kensington, and Capt. Hubert Lynes, R.N., has just left England on an expedition to Darfur, where he intends to make a special survey of the avifauna of the Jeb-Maria Mountains, which should yield many forms new to science to the Bird Department. Other similar expeditions are, we believe, contemplated by the museum authorities.

A MEETING of surgeons, representing the surgical staffs of all the great teaching hospitals of Britain, assembled in the theatre of the Royal College of Surgeons of England on January 8, under the chairmanship of Sir Rickman J. Godlee, and resolved to form an "Association of Surgeons of Great Britain and Ireland." British surgeons have thus followed the precedent set by their colleagues the physicians, who formed a similar association a number of years ago. The object of the newly formed association is to permit surgeons on the staffs of the greater hospitals to meet together from time to time at various centres in order to exchange observations and compare results. The association will stand as the representative body for British surgeons, and in that capacity will represent British interests at international surgical congresses. Sir John Bland-Sutton was elected president of the new association.

ACTIVE steps are now being taken in the movement to establish a memorial to Lord Lister in Edinburgh. The movement had already begun to take shape in 1914, but its progress was arrested by the outbreak of war. The war, which has caused delay, has given at the same time an overwhelming demonstration of the value of Lord Lister's work. The University and Royal Colleges of Physicians and Surgeons in Edinburgh, under the control of which the memorial will be established, have determined to provide an institute for research and teaching in medicine. A site has been secured, and a committee is now being formed to make an appeal to the public for a sum of 250,000*l*. Mr. Balfour, Chancellor of the University, has consented to be president of the committee, with the Duke of Atholl, Lord Rosebery, Lord Beatty, Lord Glenconner, Lord Leverhulme, and Sir J. Lorne McLeod as vice-presidents.

THE Journal of the Washington Academy of Sciences for December 19 announces that Mr. E. C. McKelvy, of the Chemical Division of the Bureau of Standards, died on November 29, in his thirty-sixth year, as the result of burns caused by an explosion of ammonia-condensing apparatus containing petroleum-ether cooled by liquid air. Mr. McKelvy was born at Upper Sandusky, Ohio, on May 9, 1884. He joined the staff of the Bureau of Standards in July, 1907, and was chief of the physico-chemical section of the Chemistry Division at the time of his death. His work for several years past had been on the physical constants of ammonia and other substances used in commercial refrigeration. He was a member of the Washington Academy of Sciences and one of the associate editors of its Journal, and had been secretary of the American Chemical Society since 1915.

AN exhibition of radiographic prints has been arranged by the Röntgen Society, and is being shown at the Royal Photographic Society's house at 35 Russell Square, W.C.1. The exhibition is open free to the public until February 7, between 11 a.m. and 5 p.m. daily. The two hundred or so prints which are hung on the walls of the gallery well illustrate present-day practice in both medical and industrial radiology as developed by some of the leading X-ray workers in this country. We hope to make extended reference to the subject in a future issue. Incidentally, the growing custom of holding joint meetings of kindred societies is one much to be commended, and we are glad to note that the Röntgen Society, in addition to its recent joint meeting with the Faraday Society, has similarly co-operated during the present exhibition with the Royal Photographic Society. Furthermore, it has arranged, in the near future, joint meetings with the Institution of Electrical Engineers and the Electro-therapeutic Section of the Royal Society of Medicine. The officers of the Röntgen Society deserve every support for their energy and enterprise.

REFERENCE is made in the *Times* of January 12 to an exceptionally high velocity, at the rate of 180 miles an hour, attained by the north-west wind at 25,000 ft. over southern England on January 9 as a precursor to the recent rough and stormy weather. Deep cyclonic depressions had spread in from the Atlantic, the central area of one passing over the northern parts of Ireland and England on January 10, and a second disturbance skirted our north-western seaboard on January 11, when the barometer in the Hebrides fell to 28·3 in. The intensity of the storm was greatest in the English Channel. In the Scilly Isles the wind attained the velocity of 68 miles an hour in a gust

during the evening of January 11. Inland the gusts attained an hourly velocity of 50 to 55 miles. Thunderstorms occurred in many parts of the country, and heavy rain was general, whilst in the Shetlands snow covered the ground to the depth of 6 in. On January 13 the Daily Weather Report of the Meteorological Office showed that the wind in the south of England was blowing at 12 miles an hour, whilst at 4000 ft. it had increased to a rate of 54 miles an hour. During the morning a storm area had its centre over Thorshavn, where the barometer stood at 29·05 in. There were indications of the approach of another disturbance from the Atlantic. The storms have occasioned several wrecks, resulting in serious loss of life.

THE death is announced of the well-known Argentine geographer and naturalist, Dr. Francisco P. Moreno. Dr. Moreno was born in Buenos Aires on May 31, 1852, and doubtless inherited his love of natural science from his mother, who was the daughter of an English botanist. He spent his early years in exploring Patagonia and various parts of the Andes, and devoted himself especially to the making of anthropological and ethnological collections. His first contribution to science, on the prehistoric cemeteries of Patagonia, appeared in the *Revue d'Anthropologie* so long ago as 1874. In 1877 Dr. Moreno gave his collection to the Argentine Government to form the beginning of the Anthropological and Archæological Museum of Buenos Aires. In 1880 Buenos Aires became the federal capital, and two years later the city of La Plata was founded to replace it as the provincial capital. Dr. Moreno then devoted his thoughts and energies to the planning and foundation of a great museum at La Plata which should illustrate the natural history of the Republic. His scheme was realised in 1889, and the well-known publications of the La Plata Museum under his direction began in the following year. In 1898 Dr. Moreno came to London as representative of Argentina in the dispute as to the Argentine-Chilean boundary, which had been referred for settlement to the British Sovereign; and in 1900 he produced his report in four handsome volumes well illustrated with photographs. At the same time he brought and exhibited to the Zoological Society the famous piece of the skin of an extinct ground-sloth which he had discovered in a Patagonian cave. Dr. Moreno was an honorary corresponding member of the Royal Geographical Society, and received the Founder's medal in 1907. He was also a foreign correspondent of the Geological Society and a corresponding member of the Zoological Society of London.

DISPATCHES published in the daily papers last week contain brief accounts of destructive earthquakes that were felt over the greater part of Mexico during the night of January 3–4. The first shock occurred at 9.45 p.m. on January 3; this was followed by a second of great intensity at 10.25, and by a slighter shock at 11 p.m. The epicentral area lies about fifty miles west of the city of Vera Cruz, near the southern end of the Gulf of Mexico, after-shocks being especially frequent to the south of Jalapa. The principal damage, so far as is yet known, is at Cordoba, Jalapa, Coscomatopec, Calcahualco, Teocelo, and Cosautlan. The area within which injury to property occurred is, however, considerable. The city of Vera Cruz is deprived of gas and water, owing to many breaks in the mains, and, even so far west as Mexico City (150 miles from the coast and nearly 200 miles from Vera Cruz), the walls of large buildings were cracked. As in all destructive shocks, the central area was completely isolated, but the unusual violence of the principal shock is also evident from the change in the course of the River San Francisco, the rupture of water-mains at Vera Cruz, and the uprooting of thousands of trees in a forest twenty-five miles from that city. The loss of life is still unknown, but is sure to be considerable. At Coscomatopec it was increased by the rush of people to the church when the first shocks were felt. According to the officials of the Mexican Government Observatory, the centre of disturbance was situated in the volcano of Orizaba, but the earthquake was clearly tectonic, possessing none of the characteristic features of volcanic earthquakes, though the opening of a new crater in the volcano may be connected with the same movement which caused the earthquake. One point of some interest is its occurrence near the north coast of Mexico, the principal seismic regions lying on the south or Pacific side.

IN "Memoirs of the Bernice Pauahi Bishop Museum, Honolulu," vol. v., part iii., for 1919, Mr. T. G. Thrum publishes a long series of native documents from the Fornander collection, giving the Hawaians' account of the formation of their islands, the origin of their race, and their migrations. The records now printed in the original language, with English translations, include fifteen mythical tales, twenty-five traditionary stories, and the legend of Kawelo, which extends to six chapters. The publication is of great importance from the points of view of ethnology, folk-lore, and linguistics.

IN the Journal of the Royal Anthropological Institute (vol. xlix., January–June, 1919) Mr. J. Reid Moir discusses the occurrence of humanly fashioned flints in the Middle Glacial Gravel at Ipswich. These implements and flakes do not exhibit marked signs of abrasion by water action, and the writer regards it as a possibility that the place where these Middle Glacial specimens are now found cannot be far removed from the deposits in which they rested in an unabraded state, and that the water which laid down the Middle Glacial deposit did not flow at a turbulent rate. The only dateable artefacts so far recovered from this gravel are some small platessiform flint implements, which, though small, otherwise resemble closely the well-known early Chellean implements. "The occurrence of flint implements of early Chellean form in a gravel presumably more ancient than the Glacial Chalky Boulder Clay will no doubt come as a surprise to many archæologists, but there does not seem to be in this case any escape from such a conclusion."

IN the *Public Health Journal* for November (vol. x., No. 11, Toronto) Prof. Fraser Harris discusses the medical and allied professions as a State service

He considers that the advantages of such a service far outweigh the possible disadvantages. Among the advantages are mentioned the speedy exclusion of quacks and irregular practitioners, and of the struggles for existence and rivalries among the regular practitioners, while the public health would be maintained as never before; treatment would be prompt and of the highest quality; specialists of all sorts easily accessible; and all manner of special treatments readily available for the rich and poor alike.

THE weekly mortality statistics of the influenza epidemic beginning in the autumn of 1918 for thirty-nine large American cities have been subjected to a preliminary analysis by Prof. Raymond Pearl (Reprint No. 548 from the Public Health Reps., Treasury Dept., U.S. Public Health Service). There was considerable variation among the several cities in the relative degree of explosiveness of the outbreak. The analysis appears to demonstrate that an important factor causing this variation was the magnitude of the *normal* death-rates occurring at the same time as the influenza epidemic in respect of pulmonary tuberculosis and diseases of the heart and of the kidneys.

IN *Medical Science: Abstracts and Reviews* for December (vol. i., No. 3) the influenza epidemic of 1918–19 is reviewed in all its aspects. In the civilian population of the United States the total number of deaths attributable to the epidemic was estimated at not fewer than 450,000, a death-rate of more than 4 per thousand. In the County of London some 22,750 deaths were caused by it. The statistics of the Life Insurance Bank of Gotha show that, whereas in 1889–90 epidemic influenza caused no deaths in the age period 15–30, in 1918 the greater number of deaths occurred in this age period—an experience similar to that which obtained in this country.

WE have received a copy of the general report of the Survey of India for 1917–18. Shortage of officers necessitated the curtailment of field work. Several officers and survey parties were supplied for Persia, Mesopotamia, and East Africa. New maps published included 43 one-inch sheets, 65 half-inch sheets, 4 quarter-inch sheets, and 13 sheets of the million map. The report gives useful index maps of all the sheets published up to the present on various scales by the Indian Survey Department.

THE United States Geodetic Survey has published a report on the connection of the arcs of primary triangulation along the ninety-eighth meridian in the United States and in Mexico (Special Publication No. 54). Mr. W. Bowie, the writer of the report, points out that this connection not only makes it possible to compute with greater accuracy than hitherto the dimensions of the earth, but also enables Mexico to extend new areas from the ninety-eighth meridian arc, which can be based on the North American datum, as the United States standard datum is now called. It had been intended to carry out this work in 1913, but the unsettled conditions in Mexico made it necessary to postpone the observations until 1916. The arc of the ninety-eighth meridian was completed to the Canadian frontier in 1907.

THE value of large-scale maps in war is the subject of an unsigned article in *La Géographie* (vol. xxxii., No. 7) on the Service Géographique of the French Army. This Service was practically created by the war, when it was realised that the available maps of France were on too small a scale to be of use. Maps on scales of 1/80,000 and 1/200,000, although valuable for war in the open, were unsatisfactory for trench warfare. Large-scale plans were available only for the neighbourhood of Paris and certain fortified places. It was decided to make maps of the war area on a scale of 1/20,000, 1/10,000, and 1/5000 (*plans directeurs*). Of these the smallest scale was for artillery use, the second for Staff work in general, and the largest scale, confined to front-line areas, for infantry use. Generally speaking, the 1/20,000 proved to be the most useful. It is hoped that this will be extended to the whole of France and be periodically revised. The urgency of the demand in war-time did not allow of detailed resurvey for this work, so recourse was had to existing survey material, land valuation plans, and aerial photography. Specimen sheets of the maps accompany the article.

IN the Bulletin of the Central Meteorological Observatory of Japan (vol. iii., No. 1) Prof. T. Okada attempts to discover a forecasting formula, starting from the undoubted fact that in Japan a hot August means a good crop, and a cold August a bad one, resulting in famine in 1902, 1905, and 1913. Prof. Okada connects the temperature of northern Japan with the sun-spot cycle, but more definitely finds a correlation between the August temperature in that region, the March pressure difference between Zikawei and Miyazaki, and the South American pressure for March to May, using data from Santiago and Buenos Aires. The South American data give larger correlation coefficients (0·5 or 0·6 with P.E.<0·1) than the Zikawei-Miyazaki pressure differences (0·3 or 0·4 with P.E.>0·1). Treating the districts of Hokkaido and Tôhoku separately, he obtains the yearly variation in the rice crop for the former as $0{\cdot}53x+0{\cdot}26y$, and for the latter as $0{\cdot}18x+0{\cdot}10y$, where x is the yearly variation of South American pressure, March to May, and y the yearly variation of pressure gradient, Zikawei-Miyazaki. The table of comparative results shows a fair agreement in sign between calculated and actual yields, especially for Hokkaido, and the conclusion is drawn that, in general, abnormally low pressure in the southern part of South America from March to May and abnormally small pressure gradient in March between Zikawei and Miyazaki are followed by a failure of the rice crop in northern Japan.

DR. G. R. WIELAND, in his "Classification of the Cycadophyta" (*Am. Journ. Sci.*, vol. xlvii., p. 391, 1919), reviews "the gymnosperm phylum," and goes much further than this in providing a table in which the evolution of dominant and specialised land-plants is correlated with the climates of successive geological periods. In this suggestive diagram various types are shown as moving towards "ascendancy and extinction" or "simplification and reduction," sharply or gently from a previous parallel course of evolution.

"Basic or semi-immortal types" of vegetation are represented by a horizontal line running across the bottom of the diagram. Elsewhere Dr. Wieland has lamented the depletion of the already small group of palæobotanists. If he could give us a general treatise on the problems expressed so concisely in his diagram, he might win a keen body of adherents.

MR. GEORGE BARROW, in a paper on "Some Future Work for the Geologists' Association" (Proc. Geol. Assoc., vol. xxx., p. 1, 1919), revives in a remarkable degree the view that some of the features of the chalk surface round London are due to marine erosion, acting probably in Pliocene times. It is urged that the quartz-pebbles of the pre-Glacial high-level gravels were washed into the chalk basin by the waters of a shallow sea, which cut passages in the escarpments and thus originated many of the wind-gaps. The chalk escarpments, together with those of the Lower Greensand, were, in their first form, ridges left by the marine denudation of the softer Gault and Eocene strata. If the "beach deposits" (high-level gravels) are of Pliocene age, no serious post-Pliocene bending of the region can have occurred, since they lie at approximately the same levels. Mr. Barrow suggests that they are little later than the Lenham Beds, and the members of the Geologists' Association are now invited to prove their age by a diligent search for fossils.

DR. R. E. SLADE and Mr. G. I. Higson, of the British Photographic Research Association, communicate to the Journal of the Royal Photographic Society (December, 1919) the results of their investigations, which show that the shape of the characteristic curve of a photographic plate depends not only on the thickness and opacity of the film and the time and method of development, but also on the relation of the different sizes of grains in the film to each other and the quantity of each size present. This new factor they claim to be the most important. If the grains are all of the same size, the curve is the steepest possible. If the grains are of various sizes, the curve is the sum of the curves due to each group of particles of the same size. The larger grains are more sensitive than the smaller grains. Uniformity of grain-size is, therefore, desirable in plates for black-and-white work, and the authors find that the steepness of the curve can be foretold from photomicrographs of the grain. Photomicrographs and curves are given in illustration.

IN May, 1914, we mentioned in these columns two methods which had been devised for reducing the measurement of the horizontal component of the earth's magnetic field to that of an electric current. In the first—due to Prof. Hicks and tested in practice by Mr. W. A. Jenkins (*Phil. Mag.*, October, 1913)—the earth's field was reversed by the current in a coil, and the reversal determined by the time of oscillation of a small magnet. In the second—due to Sir A. Schuster and tested at the National Physical Laboratory by Mr. F. E. Smith (*Terrestrial Magnetism*, March, 1914)—the earth's field was annulled by that of the coil, and a small magnet set itself at right angles to the field. In *Terrestrial Magnetism* for September, 1919, Prof. W. Uijanin, formerly of the Kazan University (from which the staff had to flee on the capture of the town by the Bolsheviks in September, 1918), gives an abstract of a paper he published in Russian in 1915 describing a third method. It retains the sine principle of the Kew magnetometer, but substitutes for the deflecting magnet a pair of coils through which a standard current measured by the potentiometer method is sent. The method gives results at least as accurate as those given by the magnetometer, and takes only a tenth of the time.

TWO useful papers on three-electrode thermionic valves have been published recently by the Bureau of Standards, Washington. The first paper, by Mr. J. M. Miller, discusses the connection between the input impedance of the valve and the load in the plate circuit. Theoretical relations are obtained which enable us to calculate the input impedance when the impedance in the plate-circuit is known. It is shown that the results are in excellent accord with experiment. It is interesting to notice that when the load in the plate circuit is inductive, the impedance can be represented as a negative resistance, in which case the valve can act as a generator. The second paper, by Mr. L. M. Hull, gives a partially successful attempt to obtain a method of rating thermionic-valve generators. A clear theoretical statement of the problem is given, and important theoretical conclusions are deduced, but experimental work is still in progress. The problem is one of considerable commercial importance, as thermionic-valve generators are now the standard source of supply for radio-telephone and radio-telegraph systems, except in the few cases when very high power is necessary. The present empirical method used for rating these generators is of little value. All interested in the subjects discussed in these papers, the numbers of which are 351 and 355 respectively, can obtain a copy of them by sending a request to the Bureau.

IN the U.S. Bureau of Standards Scientific Paper No. 350, entitled "Equilibrium Conditions in the System Carbon, Iron Oxide, and Hydrogen in Relation to the Ledebur Method for Oxygen in Steel," it is shown that mixtures of iron oxide and Acheson graphite are not, and mixtures of iron oxide with "cemented" iron or white iron (annealed or unannealed) are, reduced at 900° C. by the carbon in them when hydrogen is passed over them at rates of two litres per hour, or faster. Because of these facts it is probably impossible to determine by the Ledebur method more than 75 per cent. of the oxygen present in steels as ferrous oxide. The effect of rate of passage of hydrogen on the Ledebur oxygen-content of certain steels is shown. The paper can be obtained on application to the Bureau.

SCIENTIFIC Paper No. 347 of the U.S. Bureau of Standards describes an investigation carried out at the Bureau on the heat-treatment of alloys of the duralumin type, and the effect on the mechanical properties observed of variations in the various heat-treatment conditions. Conclusions are also drawn as

to the best conditions for the commercial heat-treatment of this alloy. A theory of the mechanism of hardening during the ageing of duralumin is proposed, based on the decreasing solubility with decrease of temperature of $CuAl_2$ in aluminium. The precipitation of this compound, suppressed during quenching, proceeds during ageing, and takes place in a highly dispersed form. To the presence of this highly dispersed constituent is due the hardness of the aged alloy. Those interested may obtain a copy of the paper on application to the Bureau.

A SHORT list of books dealing with entomology, containing 165 titles, has just been issued by *Mr. F. Edwards*, 83 High Street, Marylebone, W.1. Many of the books listed are much reduced in price.

THE latest scientific catalogue (New Series, No. 89) of *Messrs. J. Wheldon and Co.*, 38 Great Queen Street, W.C.2, contains upwards of 1500 items relating to pure and applied chemistry, astronomy, electricity, mathematics, meteorology, physics, etc. In addition, particulars are given of many sets and long runs of scientific serials and transactions of scientific societies which Messrs. Wheldon have for disposal. The price of the catalogue is 2*d*.

THE following are among the announcements of books to be published by *Messrs. Macmillan and Co., Ltd.*, between now and Easter:—"Cytology: With Special Reference to the Metazoan Nucleus," Prof. W. E. Agar, illustrated; "The Principles of the Phase Theory: Heterogeneous Equilibria between Salts and their Aqueous Solutions," D. Clibbens, illustrated; "The Theory of Determinants in the Historical Order of Development," Sir Thomas Muir (vol. iii.: The Period 1861 to 1880); "A Manual of the Timbers of the World: Their Characteristics and Uses," A. L. Howard, to which is appended an account of the Artificial Seasoning of Timber by S. Fitzgerald, illustrated; "Essays on the Surgery of the Temporal Bone," Sir Charles A. Ballance, with the assistance of Dr. C. D. Green, 2 vols., illustrated; "Space, Time, and Deity" (Gifford Lectures at Glasgow, 1916–18), Prof. S. Alexander, 2 vols.; "Implication and Linear Inference," Dr. B. Bosanquet; "Mind-Energy," Prof. H. Bergson, translated by Prof. H. Wildon Carr, in collaboration with the author; "The Idea of Progress: An Inquiry into its Origin and Growth," Prof. J. B. Bury; "Essays in Critical Realism: A Co-operative Study of the Problem of Knowledge," Profs. D. Drake, A. O. Lovejoy, J. B. Pratt, A. K. Rogers, G. Santayana, R. W. Sellars, and C. A. Strong; "A Critical History of Greek Philosophy," W. T. Stace; "Through Deserts and Oases of Central Asia," Miss Ella Sykes and Brig.-Gen. Sir Percy Sykes, illustrated; "The Handbook to Cyprus," H. C. Luke and D. J. Jardine, new edition; "The Ila-speaking Peoples of Northern Rhodesia," Rev. E. W. Smith and the late Capt. A. M. Dale, 2 vols., illustrated; "Among the Natives of the Loyalty Group," Mrs. E. Hadfield, illustrated; "England," edited by F. Muirhead (The Blue Guides); and "Highways and Byways in Northumbria," P. A. Graham, illustrated by Hugh Thomson. *The Open Court Co.* (Chicago and London) will publish shortly "A History of the Conceptions of Limits and Fluxions in Great Britain from Newton to Woodhouse," Prof. F. Cajori. It will form No. 5 of the Open Court Classics.

OUR ASTRONOMICAL COLUMN.

SPECTROSCOPIC DETERMINATION OF STELLAR PARALLAX.—Since this method of parallax determination was devised the number of stars of which the parallax has been measured trigonometrically has increased considerably. With the view of testing the accuracy of the curves used for deducing absolute magnitude from the relative strength of certain spectral lines, Messrs. W. S. Adams and G. Strömberg have made an exhaustive comparison between their spectroscopic parallaxes, which now number some 1500, and the parallaxes deduced from direct measures and proper motions; the results are given in Proc. Nat. Acad. Sci., July, 1919. The stars are divided into five spectral groups, A7 to F8, F9 to G8, G9 to K3, K4 to K9, and Ma to Md. The spectroscopic method has not yet been applied to types B_0 to A_5, as suitable spectral lines have not been found. The graphs show very satisfactory accordance, the weakest point being the fainter absolute magnitudes in the first group, where the spectroscopic determinations of distance are smaller than those measured directly. The last two groups indicate very clearly the division into giant and dwarf stars; this is also faintly indicated in the second and third groups, but not at all in the first.

The authors draw the satisfactory conclusion that "in this large amount of observational material hardly a single serious contradiction has been found between the spectroscopic and trigonometric results."

MINOR PLANETS.—Dr. F. Cohn gives his annual report on the orbits of recently discovered planets in *Astr. Nach.*, 5030. There are now 914 planets to which permanent numbers have been assigned, besides several hundreds which have been observed insufficiently; approximate orbits have been computed for about eighty of the latter. Two of the freshly numbered planets are of special interest—No. 898 for its high eccentricity, amounting nearly to 0·4, and No. 911, since it is a sixth member of the Trojan group, the mean motions of which are the same as that of Jupiter. Two others, Nos. 895 and 914, are notable for large inclinations, more than 25° in each case.

LUNAR PHOTOGRAPHY WITH THE 100-IN. REFLECTOR.—*Popular Astronomy* and Pubs. Astr. Soc. Pacific for December contain reproductions of some beautiful photographs taken with the new reflector at Mount Wilson by Mr. F. G. Pease. Silver prints have also been presented to the Royal Astronomical Society. The equivalent focus is 134 ft.; the scale is, therefore, very large, and a wonderful amount of fine detail is shown. Prof. Hale notes that the instrument is to be called the Hooker telescope, in memory of the donor of the optical parts. It is welcome news that its performance comes up to the highest expectations, and that the Mount Wilson conditions of seeing prove equal to standing this most severe test upon them. "The (radial) motions of faint stars in the heart of globular clusters and in the star-clouds of the Milky Way can be measured." Nebulium has been found in the variable star R Aquarii, and luminous clouds of calcium vapour are found to surround the star in Hind's variable nebula in Taurus. It is also possible to study the spectra of the faint companions of close double stars.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual public meeting on December 22, M. Léon Guignard in the chair, the prizes awarded in 1919 were announced as follows:—

Mathematics.—The Bordin prize to Salomon Lefschetz; the Francœur prize to Georges Giraud, for his work on automorph functions.

Mechanics.—The Montyon prize to Albert Herdner, for his work on the construction and working of locomotives; the Poncelet prize to Gen. Prosper Charbonnier, for the whole of his work on ballistics.

Astronomy.—The Lalande prize to Vesto Melvin Slipher, for his work at the Lowell Observatory, especially his researches on nebulæ and star clusters; the Benjamin Valz prize to Félix Boquet, for his work at the Paris Observatory; the G. de Pontécoulant prize to Arthur Stanley Eddington, for his studies of stellar movements.

Geography.—The Gay prize to René Chudeau, for his explorations in Western Africa; the Tchihatchef prize to E. C. Abendanon, for his book entitled "Expédition de la Célèbes centrale."

Navigation.—The prize of 6000 francs between Yves Le Prieur and Georges Sugot; the Plumey prize between Georges Raclot (1500 francs), for his experimental researches on the longitudinal flexure of ships, Maurice Poincet (1500 francs), for his theoretical and experimental researches on the blades of steam turbines, and Alfred Schwartz (1000 francs), for his work as a whole.

Physics.—The Kastner-Boursault prize to Marius Latour, for his researches on electric motors; the Gaston Planté prize to Emile Brylinski, for his work in applied electricity; the Hébert prize to Raymond Jouaust, for his work on magnetism, electrical standards, photometry, and wireless telegraphy; the De Parville prize to Louis Décombe, for his work in various branches of physics; the Hughes prize to Henri Chaumat, for his work on the industrial production of ozone, the electrolytic reduction of indigo and other dyes, and other work in electrotechnics; the Pierson-Perrin prize to Georges Sagnac, for his work on the secondary X-rays, interference, and other optical phenomena; the Clément Félix foundation to Charles Féry, to enable him to continue his experiments on the production of a small dry accumulator.

Chemistry.—The Montyon prize (Unhealthy Trades) to Georges Rivat (2500 francs), for his work on the analysis and absorption of asphyxiating gases; an honourable mention to Arnold Lassieur (1500 francs), for his contribution to the identification of the substances contained in the German poison shells; an honourable mention (1000 francs) to Cyrille Toussaint, for his chemical studies connected with the war; the Jecker prize between Ernest Fourneau (5000 francs), for his services relating to the synthetical preparation of medicinal organic compounds, Louis Maillard (2500 francs), for the whole of his work in organic chemistry, and Marcel Sommelet (2500 francs), for his researches on the ether oxides, the homologues of benzyl chloride, alcohols, and aldehydes; the Cahours foundation divided equally between Georges Mignonac and Marcel Murat, for their work in organic chemistry; the Houzeau prize to René Locquin, for similar researches.

Mineralogy and Geology.—The Delesse prize to Frédéric Roman, for his geological and palæontological work; the Victor Roulin prize to Léonce Joleaud, for the whole of his work; the Joseph Labbé prize to Pierre Pruvost, for his studies on the Coal Measures of Northern France.

Botany.—The Montagne prize between Fernand Moreau (1000 francs) and Gabriel Arnaud (500 francs); the Jean Thore prize to Auguste Sartory, for his publications on cryptogamic botany; the De Coincy prize to C. Houard, for his work on the cecidology of European Phanerogams; the Jean de Rufz de Lavison prize to Raoul Combes, for his researches on the absorption of glucosides by plants and on plant pigments.

Anatomy and Zoology.—The Cuvier prize to J. Jolly, for his work in histology; the Savigny prize to Louis Boutan, for his botanical and zoological studies in the Red Sea and Indo-China.

Medicine and Surgery.—Montyon prizes to Michel Weinberg and Pierre Séguin (2500 francs), for their memoir on gas gangrene; Louis Martin and Auguste Pettit (2500 francs), for their memoir on icterohæmorrhagic spirochætosis; Henri Rouvillois, Guillaume Louis, Albert Pédeprade, and Antoine Basset (2500 francs), for their studies on war surgery. Honourable mentions (1500 francs) to Jean Fiolle and Jean Delmas, for their book on the discovery of the deeper vessels; to Alfred Boquet and L. Nègre, for their work on epizootic lymphangitis; and to H. Gougerot, for his work relating to venereal diseases. The Barbier prize to Albert Goris, for his work on the localisation of glucosides in plants and on the preparation of catgut for surgical purposes; the Bréant prize (arrears) to Paul Ravaut (3000 francs), for his researches on malaria, and to Lucien Camus (2000 francs), for his researches on infection and vaccinal immunity; the Godard prize to Albert Pézard, for his researches on the genital glands; the Chaussier prize between Albert Dustin (3000 francs), for his studies relating to neurology, embryology, and histology, Marcel Frois and Barthélemy Caubet (3000 francs), for a memoir on fatigue in industrial work, Adrien Grigaut (3000 francs), for his memoir on new chemical methods in pathology and their results, and Hector Marichelle (1000 francs), for his researches on the mode of production of speech sounds; the Mège prize (encouragement of 300 francs) to Jules Glover; the Bellion prize to the late Georges Demeny, for the whole of his work, and a very honourable mention to Humbert Boucher; the Baron Larrey prize to Camille Lian, for his memoir on the cardiac troubles of soldiers; the Argut prize to Robert Pierret, and a citation to Victor Raymond and Jacques Parisot, for their memoir on trench-foot.

Physiology.—The Montyon prize to Robert Lévy, for his work on the toxins of genital products of certain animals; the Lallemand prize to Léon Binet, for his monograph on trembling, and a very honourable citation to E. Couvreur and E. Duroux, for their work on nerve-lesions, and to André Léri, for his memoir on war-shock and emotions; the Philipeaux prize to Mme. Lucie Randoin-Fandard, for her researches on blood-sugar; the Fanny Emden prize to Léon Chevreuil, for his memoir on existence after death.

Statistics.—The Montyon prize to Arthur Chervin, for his book on Germany of to-morrow.

History and Philosophy of the Sciences.—The Binoux prize to the late René Larger, for his publications on the extinction of species by degenerescence and the theory of counter-evolution or degenerescence by pathological heredity.

Medals.—The Berthelot medal to Georges Rivat, Louis Maillard, Marcel Sommelet, and René Locquin.

General Prizes.—Grand prize of the physical sciences to Louis Roule, for his researches on the migrations of fishes; Petit d'Ormoy prize to Henri Lebesgue, for his mathematical works; the Estrade Delcros prize to H. Perrier de la Bathie, for his scientific work in Madagascar; the J. J. Berger prize between Paul Juillerat and Emile Gérards; the Saintour prize to Eugène Pagézy, for his anti-aircraft work; the H. de

Parville prize between Héloïs Ollivier (1500 francs), for his course of general physics, and Adrien Loir and H. Legangneux (1500 francs), for their work entitled "The Products of the Sea"; the Lonchampt prize to Camille Delezenne, for his work on the presence and rôle of zinc in animals; the Henry Wilde prize between Jean Rey (1000 francs), for his researches on projectors, and Adrien Bochet (1000 francs), for his mechanical and optical inventions; the Thorlet prize to Adolphe Richard, for his catalogue of scientific books in the libraries of Paris.

Special Foundations.—The Lannelongue foundation to Mme. Cusco and Mme. Ruck.

The Laplace prize to Robert Henri Le Besnerais, Maurice Victor Duruy, and the late Charles Marie Carcopino-Tusoli; the L. E. Rivot prize to Robert Le Besnerais and Maurice Duruy (each 750 francs), Louis Delmas and Henri Pagezy (each 500 francs), Joseph Fontaine and Albert Masselin (each 750 francs), Robert Besse and Henri Lang (each 500 francs).

Foundations for Scientific Researches.—The Gegner foundation to René Baire, for his work on the general theory of functions; the Charles Bouchard foundation to Jean Camus, for the continuation of his work on nerve reactions, the regeneration of nerves, and the effect of various poisons on the nerve-centres.

[*Note.*—As in former years, the Bonaparte and Loutreuil foundations have been omitted, and will be dealt with in a separate article.]

EDUCATIONAL CONFERENCES.

THE eighth annual Conference of Educational Associations was held at University College, London, on December 31–January 10. Three tendencies could be observed in the lengthy list of lectures and discussions arranged for this well-attended conference: the preparation of the citizen, testing for capacity, and care for the artistic side of life. The Master of Balliol took "The Education of the Citizen" as his topic before the Training College Association, while to the Assistant Mistresses' Association Mr. Evan Hughes lectured on "The Importance of a Wider Knowledge of Economic Principles." Under this head, too, came a discussion of continuation schools and their possibilities. Sir William Ashley, in presiding at a joint conference on this topic, emphasised the difficulty of forecasting the labour demand of different occupations, and of anticipating the place that skill would occupy within any one industry. Mr. Spurley Hey, Director of Education, Manchester, found his difficulties in the provision of buildings and teachers, and was critical of works schools; whilst Mr. Beresford Ingram was more distressed by the problem presented by the small employer. The Civic Education League also took up this question in a discussion on education and industry, which largely turned upon the problem of the works school, and, in conjunction with the Infant Welfare Association, arranged a course of twelve lectures dealing very thoroughly with the whole question of infant care and child nurture.

Eugenics entered into this course, but was more specifically treated by Dr. R. Douglas Laurie, who lectured on "Eugenics Education in the Training College," and at a later session on "Eugenics Education in the School," before the Eugenics Education Society. He would not allow the feeble-minded criminal to hand down his qualities, or the aggravated pauper to pass on his inherent pauperism; and the question of deaf-mutes and epileptics should be considered. The eugenic point of view should be part of the mental constitution of every normal citizen, and to this end he would have some measure of biological training given to every boy or girl. This should begin with Nature-study, develop into physiology, and then into hygiene, which should lead on to eugenics.

A correlative of such teaching was to be found in a brilliant lecture by Dr. Olive Wheeler to the Assistant Mistresses' Association on "New Views of Human Personality." Dr. Wheeler contrasted the mechanistic tendencies of the nineteenth century with those of a more idealistic character which were becoming current in the twentieth. This change she traced largely to the development of modern biology and psychology. The child was born with certain dynamic forces: the instincts as described by McDougall, the appetites as outlined by Drever. These powerful impulses needed expression; if repressed, they still existed in the realm of the unconscious, and continued to influence conduct. Attention was directed to Bergson's view that the essential difference between a living organism and a machine was the power of creation and the importance he attached to that modification in the "urge," or dynamic flux, which caused an organism to move in a specific direction.

The problem of testing capacity was first raised by Mr. G. F. Daniell, of the Kent Education Department, in opening the discussion on "The Selection of Elementary Children for Higher Forms of Education." Mr. Daniell favoured a preliminary examination in the elementary schools of pupils between ten and twelve years of age, by which some would be selected for a final examination, to consist of written tests in English and arithmetic. The teacher's report and the school record should be considered, and an interview arranged in at least all doubtful cases. Psychological tests he held to be useful and valuable in this connection, and he thought that careful inquiry did not support the view that the largely written character of the examination excluded from the secondary schools all who were gifted in artistic work and craftsmanship, though it would be well to include in the examination a test of such ability, could one be devised that was both satisfactory and easily applied.

The question of psychological tests was dealt with by Dr. P. B. Ballard in his lecture on "The Measurement of Practical Ability" before the Educational Handwork Association. Dr. Ballard's incidental exhibition of the well-known tapping machine for testing innate motor ability was largely reported in the Press, and equally misunderstood. The whole subject was treated more fully in his lecture on the following Monday to the British Psychological Society on "The Development of Mental Tests," one of the most successful and largely attended meetings of the conference. He pointed out that the history of mental testing was, in the main, an attempt to introduce mathematics into the solution of the problem of the selection of ability. The earliest attempts were in the direction of finding some physical correlate of mind, as in the phrenology of Gall, the physiognomy of Lavater, and the criminology of Lombroso. But neither such static measurements, nor the later applied dynamic measurements of motor response to stimulus, gave results that were valid beyond their own sphere. They had passed from the physical to the psycho-physical, and were now reaching out to the psychical tests. But success in securing standardised tests and measurements depended upon three mathematical conceptions: that of a definite scale for the measurement of intelligence first devised by Binet, much abused but much used; that of the law of normal distribution enunciated by Quetelet, but first applied to mental traits by Galton; and that of the doctrine of correlation, suggested also by Galton, but elaborated by Prof. Karl Pearson and by Prof. Spearman. The same subject received further treatment by Prof. John Adams in a lecture on "Tests

of Intelligence" before the Association of University Women Teachers, wherein he pointed out the dependence of efficiency of intelligence upon its environment, and the well-marked distinction that tests had revealed between knowledge and capacity; educational attainments did not hide lack of intellectual ability.

Within the artistic sphere of the conference were embraced play, music, dancing, and the drama, all popular and suggestive topics. Prof. James Shelley gave a thoughtful lecture on "The Seriousness of Play" before the Froebel Society; Dr. Somervell treated of "The Place of Music in Education" before the Girls' School Music Union, as did Mr. Stewart Macpherson before the Association of Head Mistresses, before which also Mr. Burret Carpenter lectured on "The Place of Art in Education." Very popular, too, were the lecture, with demonstration, on "Folk Dancing" by Mr. Cecil Sharp before the English Folk Dance Society, and that on "Eurhythmics" by M. Jaques-Dalcroze, and held at the Lyceum Theatre; whilst the British Drama League drew a crowded house to hear Mr. Ben Greet's account of the great work being done in London in introducing the acted Shakespeare play to children from the elementary and secondary schools in school-time.

Altogether it was a very full conference, but those who attempted the whole course could only save themselves from "mental indigestion" by applying to the lectures Mr. Fisher's dictum about books given in his opening address. "Some books live to be skimmed; others claim to be studied minutely in whole or in part. The true reader discerns his proper food by intuition."

Geographical Association.

The annual meetings of the Geographical Association were held in London on January 9–10. Sir C. P. Lucas, in his presidential address, opened out fresh lines of thought concerning islands as centres of preservation of human diversities and their relations to peninsulas, all in connection with the development and fate of empires and commonwealths. He suggested that the giving of self-government to British Colonies and Dominions might be due to home experience of diversities within the British Isles and of the need for giving each group opportunities of development in its own way.

Dr. R. N. Rudmose Brown emphasised the development of the coal export trade from Spitsbergen, and estimated that next year 250,000 tons of coal would be shipped. He referred to the extra-territorial rights of British, Swedish, and Russian estates within the new Norwegian dominion of Spitsbergen created by the Paris Conference.

The educational side was dealt with by Mr. T. W. F. Parkinson, who urged that the Board of Education should do more to encourage geography in the higher forms of secondary schools, and that more scholarships should be opened to students of geography. The discussion brought out references to the creation of a Geographical Tripos at Cambridge and to the full recognition of geography in the faculties both of arts and of science by the University of Wales, as well as to the new creation of an arts degree (Pass and Honours) at Leeds and London.

An important demonstration of the value of the kinema in geographical teaching was given to a large audience by Capt. C. E. Hodges. Mr. M. de Carle S. Salter, Superintendent of the British Rainfall Organisation, gave a very valuable original paper on rainfall as a geographic function.

Science Masters' Association.

The annual general meeting of the Science Masters' Association was held at the London Day Training College on January 6 and 7. The president (Mr. W. W. Vaughan, Master of Wellington College), in his address, directed attention to the importance of science as part of a liberal education. But the aim of scientific education must not be commercial prosperity. History taught that utilitarian science always degenerated. The object of education is the liberating of man's soul.

The following subjects were then discussed:—(1) The teaching of organic chemistry (Mr. W. J. Gale, King's College School, Wimbledon). (2) Biology in the school syllabus. Mr. F. W. Hodges (Cooper's School, Bow) urged the necessity of making biology an integral part of school science. Prof. Hickson (Manchester) supported this view, and contended that it was impossible to teach the science of life from plants only. (3) Laboratory management (Mr. H. Preston, Caistor Grammar School). (*a*) *The Training of Assistants.*—In order to obtain suitable boys, the occupation of laboratory assistant must not be allowed to remain such a blind-alley occupation as it is at present. Proper provision should be made to fit these boys for a career, and to provide suitable education for them. (*b*) *Cost of Apparatus.*—The high cost of apparatus is detrimental to the necessary expansion of science teaching at the present time. Mr. Preston considered that the cost was unnecessarily high in many cases, and indicated that science teachers were being exploited or else that British manufacturers were incapable of producing apparatus at a reasonable cost. As the result of this discussion a committee was appointed to inquire into the matter.

In the evening an interesting lecture was delivered by Dr. Crommelin on the British observations during the solar eclipse of May last. After giving a brief, but clear, outline of Einstein's theory and the experimental work which led up to it, Dr. Crommelin described the measurements of the deflection of light-rays passing close to the sun, as shown by the positions of star images on the photographic plates.

On January 7 the subjects discussed were as follows:—(1) Science teaching in the early stages. Major V. S. Bryant considered that science in preparatory schools should be part of the whole teaching, and not segregated. In the discussion the conclusions arrived at were:—To avoid so-called "practical measurement"; to stimulate the boys' interest, and that not less on the biological than on the mechanical side; to avoid restricting natural history to biology; and to give adequate attention to the teaching of English. (2) The divorce of laboratory and class-room courses (Sir Richard Gregory, and Mr. G. D. Dunkerley, Watford Grammar School). Sir Richard Gregory's paper was mainly a reaction against the idea that the only science teaching of value is that given in the laboratory. This view has led to the neglect of those sciences which do not lend themselves to experimental treatment, and hence the undue prominence given to physics and chemistry. The "science for all" courses of the S.M.A. are conceived in the new spirit of science teaching. Laboratory work should not merely be exercises in measurement, but also deal with subjects which cannot be treated in any other way. Laboratory work is intended to give an idea of scientific method; class-room courses should give a broad survey of scientific facts, principles, and achievement.

THE PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

THE tenth annual exhibition of electrical, optical, and other physical apparatus, arranged by the Physical Society of London and the Optical Society, was held on January 7 and 8 at the Imperial College of Science, South Kensington. For the first time, we believe, the exhibition extended over two days. The

extent of the exhibits was also greater, two floors of the physics department of the Imperial College being occupied in place of one, as in previous years, the last being 1913. To some extent this expansion was due to a special reason, namely, the inclusion of a supply of German instruments captured during the war, shown by permission of the Admiralty, the Air Ministry, and the War Office. The attendance was very satisfactory. The fact that the annual Conference of Educational Associations was meeting in London during the week allowed many teachers the opportunity to pay a visit, and we believe this was taken full advantage of.

There are two sides to an exhibition of this kind, the educational and the commercial, and the two react. The visitor is anxious to buy as well as to learn; the exhibiting firms are ready to learn as well as to sell. There is much intercourse and interchange of ideas, which may fructify later in the improvement of old instruments and in the devising of new.

Although business affairs are by no means stabilised as yet, the standard reached by the exhibits shows that a keen, progressive, and enterprising spirit is alive amongst makers of scientific appliances. It is not surprising to learn that a great exhibition of products of the British Empire, to be held in London in 1921, is already in hand.

Two discourses which attracted good attendances were given daily; one on "The Use of Light in the Transmission and Reproduction of Sound," by Prof. A. O. Rankine; the second on "Some Polarisation Experiments," by Prof. F. J. Cheshire. In the former was given an exposition of an application of the selenium cell, which suggests the possible supersession of the purely mechanical method of reproduction of speech and music by the gramophone.

A marked feature of the exhibition was the large number of demonstrations of apparatus in action. There is no doubt that this is widely appreciated, and that the effects in stimulating interest and inquiry are fully commensurate with the pains taken by the firms concerned. Amongst these may be mentioned the production of electrical oscillations by the triode thermionic tube, the indirect compensated illumination known as "Sheringham daylight," and Mr. Darling's simple device for indicating the quenching temperature in the hardening of steel. The model aeroplane cabin with its array of instruments *in situ* (shown by Hughes and Son) was also most instructive.

It is impossible in a brief survey to do justice to all the items of apparatus displayed, or to the firms who participated; only a few can be referred to. First, we would mention thermionic tubes. Few are unaware of the great use that was made of these instruments in the course of the war, and of the many purposes for which they can be employed; and one was naturally prepared to find, though not less grateful on finding, a fairly complete exhibition of various stages in the evolution of the diode, and especially of the triode, forms of tube. These were shown by the Marconi-Osram Co., the Edison-Swan Co., and H. W. Sullivan, the production of electrical oscillations by use of the triode tube being demonstrated.

The electrical CO_2 recorder (the Cambridge and Paul Instrument Co.) for the testing of flue-gases furnishes an interesting example of the application of physical principles in combination. The percentage of carbon dioxide in the flue-gases determines the thermal conductivity of the gas; this determines the rate of cooling of an immersed heated platinum wire; and this in turn determines the current in the galvanometer of an unbalanced Wheatstone bridge, of which the platinum wire constitutes one arm. This example recalls another instance of the application of indirect measurement, namely, the dionic (?) water-tester (Messrs. Evershed and Vignoles), where the electrical conductivity serves to indicate the extent of inorganic impurity present.

A collection of glasses by Chance Bros., though on a modest scale, was of great interest. It included the Crookes spectacle glasses, which protect the eye by cutting out the ultra-violet rays, and an ultra-violet glass, opaque to the visible spectrum, but transmissive of the ultra-violet. Demonstrations of their properties were made by the aid of a nichrome arc and a fluorescent screen of barium platinocyanide.

Amongst Hilger's instruments for refined optical measurement we may single out the vacuum spectrograph (shown by courtesy of Prof. Fowler), which permits of photographing the spectrum in the Schumann region.

Optical instruments of high quality were displayed by many firms, including Charles Baker, Hughes and Son, Bellingham and Stanley, Davidson and Co., Watts and Son, W. Ottway and Co., Penrose and Co., Watson and Sons, Newton and Co., and Rheinberg and Co. Exhibits of books by the Cambridge University Press, Macmillan and Co., and several other firms were much appreciated.

There is room, we think, for one criticism of the quality of the exhibits. We refer to the comparative absence of simple forms of apparatus. There is a great need, for teaching purposes in schools and colleges, of apparatus, made without elaboration, of an open type that will proclaim its principle at a glance. Dr. Searle's apparatus occurs to one as a good example of the type desired. Collaboration between teachers and manufacturers would serve to hasten a development that is urgently required, and we commend this field to the attention of both. D. O.

THE CHARTERS TOWERS GOLDFIELD.

THE Geological Survey of Queensland has published a very complete description of the Charters Towers goldfield by Mr. J. H. Reid (Publication No. 256). Although this was for long the most important goldfield in Queensland, and had, in fact, for many years the largest gold output of any of the individual goldfields in the whole of Australia, no full account of the geology of the field or of the nature of the ore deposits has yet been published, so that the issue of the present monograph is fully justified. Furthermore, had the issue of such a work been delayed much longer, it could never have been carried out effectually, as many of the mines are now closing down. The goldfield was discovered in 1871, and ten years later the gold production was close upon 75,000 oz. of gold bullion; in 1887 this output had doubled, reaching 151,500 oz.; and in 1899 the highest output, namely, 319,572 oz. of fine gold, was attained. From that time the production has been a steadily declining one, the drop since 1912 having been particularly rapid, until in 1916 the output was only 33,107 oz.

Unfortunately, it is only too clear from the report that this falling off is not a temporary phase, but is due to the very nature of the gold deposits themselves, and that the field is rapidly approaching exhaustion. It is shown that the principal country rock is a granodiorite of Lower Devonian or pre-Devonian age, traversed by numerous dioritic dykes and by well-marked systems of fault-fissures, the throw of the latter being generally inconsiderable. Within the zones of shattered rock accompanying these fissures veinlets of auriferous quartz have been deposited, undoubtedly, according to the author, by hydro-thermal agencies. The veins are, for the most part, narrow, ranging as a rule from a few inches to 5 ft. in thickness,

anything more than 5 ft. being considered exceptionally large.

There are two main auriferous belts, both running north-east to south-west; the more northerly one, containing all the more famous lodes, such as the Day Dawn and the Brilliant, is about three miles long and three-quarters of a mile wide; the less important southerly belt is of about the same length, but never exceeds 200 yards in width. A small number of scattered mines have been worked outside these belts, but most of these are now closed down. The noteworthy feature of all the lodes is that, whilst the fissures persist in depth, the gold values do not, the mines as a whole showing progressive impoverishment in depth. To quote the author:—"It can be affirmed that pay shoots between the surface and the 1000-ft. level were richer than those between 1000-ft. and 2000-ft. levels, and that these were correspondingly richer than those found below 2000 ft."

THE NEW ZEALAND SCIENCE CONGRESS, 1919.

NEW ZEALAND occupies a unique and advantageous position for scientific work. Situated in the midst of the vast Pacific, she has splendid opportunities for the pursuit of the fascinating studies of oceanography and the meteorology and astronomy of the southern hemisphere. Innumerable problems in geography, geology, and physiography, of an entirely novel and supremely interesting kind, present themselves, not only in New Zealand itself, but also in the surrounding Pacific and further south in the mysteries of the Antarctic. In her flora and fauna and native races, in her varied mineral wealth, in her large reserves of water-power, both fluvial and tidal, there are endless opportunities for the man of science. In her political, social, and economic institutions she is bound to make valuable contributions to experimental sociology; and it is the experimental side that chiefly matters and stands most in need of encouragement in these days of nebulous theories and unsubstantial visions.

It is perhaps only natural that, in her present stage of development and in view of the smallness of her population, New Zealand should appear to limit her research outlook chiefly to matters of a practical and utilitarian nature. In such a purely agricultural community it is only to be expected that the biological sciences—applied botany and zoology—should occupy a predominant position, as is clearly evidenced by the election of a distinguished botanist as president of the New Zealand Institute and Science Congress, and also by an analysis of the contents of the first fifty volumes of the institute's Transactions. Such analysis discloses that, of the papers contributed, zoology claims 1143; botany, 654; geology, 503; anthropology, 204; physics (including astronomy and meteorology), 152; chemistry, 135; engineering, 76; mathematics, 40; economics, 37; history, 34; metaphysics, 22; medicine, 20; literature, 15; education and statistics, 12 each. It must be remembered, however, that many valuable contributions do not appear in the Transactions; some are published in scientific journals in Great Britain; the Geological Bulletins and the Palæontological Bulletins of the New Zealand Government absorb others. The *Polynesian Journal* takes most of the papers on anthropology.

In commenting on the predominance of the natural history papers, the president, Dr. Cockayne, pointed out that this is only to be expected in a new land with both flora and fauna so little investigated and containing so much that is endemic. Most of the papers are devoted to classification. "This must have been so; it is the natural evolutionary process in the history of biological research the world over. . . . As for chemistry and physics, which make but a poor showing in the work of the New Zealand Institute, little progress can be made in these sciences without well-equipped chemical and physical laboratories and men specially trained in such. Laboratories of this class are now attached to the various university colleges, and chemical and physical contributions—the work of trained students—are slowly but surely finding a place in the Transactions."

When it is remembered that the institute only receives the small sum of 500*l.* per annum as Government grant it is a matter for amazement that so much work has been accomplished. A levy of 200*l.* was made on the affiliated societies, which could ill afford it, but yet there are scarcely funds sufficient to publish the Transactions. Many papers of great value await publication, and much work of national interest awaits initiation. Government financial support and public sympathy are both badly needed, and it is hoped that the Science Congress, the first of its kind in New Zealand, will go far to supply these needs. The Government has, as a matter of fact, promised to do its utmost to place the institute on a firm financial footing, and has already made special grants for economic science.

The New Zealand Institute consists of a number of incorporated societies, namely, the Auckland Institute, the Wellington Philosophical Society, the Philosophical Institute of Canterbury, the Otago Institute, the Hawke's Bay Philosophical Institute, the Poverty Bay Institute, the Manawatu Philosophical Society, the Wanganui Philosophical Society, and the Nelson Institute. The management of the New Zealand Institute is vested in a board of governors representative of the incorporated societies and of the Government, and this board meets annually in Wellington in January.

The Science Congress, organised by the institute this year and held in Canterbury, was the first of its kind in the Dominion, and owed its inception largely to proposals for the reform of the institute made by Dr. J. Allan Thomson in 1917. Dr. Thomson said: "In its relation to the public the New Zealand Institute should, but does not, hold a position analogous to that of the British Association for the Advancement of Science, the body which most keeps the public in touch with science, and from which most of the improvements in the State attitude to science have had their origin. The Australasian Institute for the Advancement of Science meets too seldom in New Zealand to be effective in this direction." The Congress was opened by the Governor-General of the Dominion, who, in his address, enumerated four important matters for investigation and study, namely, (1) public health and pandemic disease; (2) afforestation; (3) the mineral oil industry; and (4) fisheries. The Hon. G. W. Russell, Minister of Internal Affairs, urged the development of natural resources, especially hydro-electric power, and promised the institute adequate financial support. "The State must be prepared to foot the bill. I therefore urge the Science Congress to press upon the Government that without Governmental expenditure science cannot grow and expand; that scientists cannot live on air or on the hope of posthumous fame; and that therefore, if the Dominion is to develop by means of science, adequate funds must be provided for research, for the training of teachers and professors, for the equipment of laboratories and staffs, and for the creation of the scientific atmosphere of which I have spoken."

The president of the Congress (and of the New Zealand Institute), Dr. L. Cockayne, gave a brief

historical account of the institute and described its immediate aims and aspirations. These are mostly agricultural at present, and in such a farming community nothing demands years of close study more than the soil itself. The world over, soil science, notwithstanding many books on the subject, is in its infancy. Chemical analysis of a soil, even with far better methods than those now available, is only one part of the question. The extremely difficult problems of soil-physics at once confront the investigator. Then there is the rich soil-flora and the rich soil-fauna. When more of a fundamental character is known as to the relation of soil-physics, soil-chemistry, and soil-biology to one another, then, said the president, undoubtedly new methods of soil-utilisation will be in sight. In the domain of anthropology Dr. Cockayne made the interesting suggestion that there is no need to confine one's investigations to primitive races, for amongst the settlers in a new land evolution in certain directions goes on apace. The question of dialect, for instance, among the white people of New Zealand would form a valuable study.

Although the presidential address was mostly biological, it is sufficiently evident, from an examination of the numerous and varied papers read, that other important branches of science are not to be overlooked by the institute. *Section* 1, *Biology and Agriculture*, had several papers of value and interest to the agriculturist, concluding with one by Sir James Wilson on "Agriculture's Debt to Science." *Section* 2, *Geology*, had papers on "The Older Gravels of North Canterbury," by R. Speight; "The Significant Features of Reef-bordered Coasts," by W. M. Davis; "Rough Ridge, Otago, and its Splintered Fault-scarp," by C. A. Cotton; "Natural Features of the Arthur's Pass Tunnel," by F. W. Hilgendorf and others; and "Geology of the Middle Clarence and Ure Valleys," by J. Allan Thomson. These and other papers will ultimately appear in the Transactions. Dr. Thomson also gave some interesting notes on the geology and palæontology of the Palliser Bay district, and a quantitative study of the silica-saturation of igneous rocks, suggesting a valuable means of comparing rock analyses. About a thousand such analyses have been calculated and plotted, and it is hoped to continue the work with the aid of a Government research grant.

Mr. E. K. Lomas dealt with some of the educational aspects of geography, and his opening remarks are well worth quoting: "Education, from one point of view, consists in bringing a mind into close touch with its environment through the senses. The more often the mind is roused to activity by excitations from the outside the more it develops. The special section of the environment in which we are particularly interested—I speak to a meeting of geologists—is that included under the term 'geology'; and the only means we have of introducing our subject into the schools is through the medium of geography, so that this subject should be an object of lively interest to all present. And there is no doubt about it, we shall have to take more interest in the subject for several reasons: (1) it is developing rapidly, (2) it is eminently suitable for educational purposes, (3) the present ignorance of geography is truly alarming and deplorable." If this be true of New Zealand, with its excellent educational system, it is still more applicable to this country. One of the most valuable papers in the geology section was "The Organisation and Functions of a State Geological Survey," by Mr. P. G. Morgan. This gave a brief account of most of the existing State geological surveys in the United Kingdom, Europe, India, Canada, the United States, Australia, and New Zealand, with suggestions for the organisation of such surveys in general and for New Zealand in particular.

In *Section* 3, *Chemistry, Physics, and Engineering*, Mr. D. M. Y. Sommerville described an improved planisphere and a slide rule for solving the quadratic equation. Dr. C. E. Adams, Government Astronomer, read a paper on "Tables of Mathematical Functions." Mr. Evan Parry, Government Electrical Engineer in New Zealand, said these tables constructed by Dr. Adams were of great value, for the ordinary tables of natural logarithms were not sufficiently minute for practical use in electrical work. Dr. Adams also gave another very interesting paper on "The Harmonic Analysis of Tidal Observations and the Prediction of Tides." No arithmetical approximations are used, so that a criterion is obtained with which to test the application of Fourier's series to tidal observations. The method of tide-prediction used in New Zealand is a graphic one, controlled by calculation, and is fully illustrated and described in the Survey Reports of the Lands and Survey Department for the years 1910–14. The results for Wellington and Auckland are published in the New Zealand Nautical Almanac by the Marine Department.

In his paper on "The Porosity of Porcelain," with special reference to high-pressure insulators for electric transmission lines, Mr. C. C. Farr said that the tests were made at the suggestion of the engineers of the Lake Coleridge electric supply system, who desired a method for determining whether the porcelain of the insulators was porous or not. The tests were carried out in the physical laboratory of Canterbury College by immersing specimens of porcelain in a fuchsin or red-ink coloured solution under a pressure of 2000 lb. per square inch, the solution being contained in a hole 3 in. in diameter and 6½ in. deep bored in a block of solid steel and covered with a steel cap 1 in. thick and a leather washer by means of eight bolts. Both glazed and unglazed porcelain was subjected to test, and it was concluded from the results that (1) density and porosity have little or no connection with each other, (2) porcelain can be made which shows no penetration after fifty hours' immersion under the pressure named, (3) porcelain is not always so made, and may contain a porous layer with abrupt edges in the mass of the substance. The experiments are being continued.

In a paper on "The Interference of Power Circuits with Telephone Circuits" Mr. E. Parry presented a mathematical treatment of the subject, as complete as possible, with the view of co-ordinating results of past experience and enabling effects to be predicted under given conditions, with special reference to the Lake Coleridge transmission lines. The New Zealand Public Works Department, together with the Post and Telegraph Department, has for some time been studying the influence of power circuits on telegraph and telephone circuits, since the wires for both services are supported on the same poles.

In Mr. E. E. Stark's paper on "The Effect of Low Power-factor from the Viewpoint of Electric Power Station Operators" it was suggested that the power stations using the alternating current system should charge the consumer for the total current taken, including both power-producing and wattless current—that is to say, the charge should be based on kilovolt amperes instead of kilowatts. If it is desired to equalise the rates without raising the price of electricity, an average power factor could be taken on a given system and a reduction made. Mr. H. Hill read a paper on "National Hydro-electric Schemes for New Zealand," in which he said it was difficult to understand the delay in formulating a national elec-

tric scheme for the Dominion. Mr. E. Parry's great North Island scheme should be put in hand at once, including the electrification of the East Coast railway. The people in the South Island also should insist on a national scheme.

Dr. Adams, in addition to his papers already noted, read others on (1) "Determination of the Position of the Moon by Photography," illustrated by photographs from the Lick Observatory. The very fine star images secured indicate the high efficiency of the Crossley reflector telescope, which was driven without any guiding, and the photographs prove that the position of the moon and terrestrial longitude can be determined with high precision. (2) "The Almucantar Method for Determination of Time and Latitude." (3) "A Nomogram for Transit Instrument Star Factors." Dr. Adams exhibited also some photographs on glass of the solar corona received by the Hector Observatory from Dr. W. W. Campbell, of the Lick Observatory in California. The photographs were taken by the Crocker Eclipse Expedition on June 8, 1918, at the total eclipse of the sun, with a 40-ft. camera pointed directly at the sun, and using 10 in. by 12 in. plates. The Lick Observatory had most remarkably good fortune at this eclipse: the sky had been completely cloudy all day, but cleared up in the neighbourhood of the sun one minute before totality, and this small portion of the sky remained clear until a few seconds after totality. The small region of unclouded sky containing the totally eclipsed sun seemed to be quite clear and was the bluest sky seen by the expedition.

Section 4, *General*, had papers on "Moriori Art," by Mr. H. D. Skinner, lecturer on ethnology at Otago University; "The Language of the Chatham Islands," by Archdeacon H. W. Williams; and "The Natural Laws of Poetry," by Mr. J. C. Andersen. The following papers, read in the General Section, should more properly have been included in Section 1, viz. "Afforestation in New Zealand," by Mr. W. H. Skinner; "Some Proposals with regard to Natural Afforestation in a New Zealand Mountain Area," by Mr. W. G. Morrison; and "Preservation of New Zealand Fauna," by Mr. E. G. Stead.

THE AFRICAN RIFT VALLEY.[1]

AFTER the discovery of Lake Rudolf in 1888, Suess showed that the Jordan, Dead Sea, and Red Sea fractures were not continued along the coast of Africa, but through the East African lake chain, the basins of which had been formed by the foundering of their floors between parallel faults. During an expedition to British East Africa in 1892–93 Prof. Gregory confirmed Suess's conclusions, with some modifications as to the age and origin of the Great Rift Valley, the formation of which he attributed to successive faulting during the great earth movements of the Kainozoic era.

The Rift Valley has been traced from northern Palestine to southern Africa. Its structure varies with its age and the nature of the country traversed. Thus the fault-scarps are better preserved along the Gulf of Akabah than in the older sections which enclose the Red Sea and the Gulf of Suez. The section in southern Abyssinia which connects the Red Sea with Lake Rudolf and the Rift Valley in British East Africa is locally irregular where intersected by the cross fractures that bound the sunk land of the Gulf of Aden. Across British East Africa the valley is a comparatively simple trench; its walls are often so steep that Sir John Bland-Sutton describes them as "as steep and abrupt as those of a grave," and for long the Uganda Railway worked its trains between the valley and plateau by a rope incline, and there is still no road for wheeled traffic from Nairobi to the floor of the Rift Valley.

South of British East Africa it has been claimed that the Rift Valley comes to an end, only its western wall being continued as a fault-scarp. This arrangement occurs near Lake Manyara, where the eastern side is a long, smooth slope which ends westward at the foot of the fault-scarp that bounds the Giant Cauldron Mountains. The structure may be explained as an extreme case of the asymmetry due to the different strengths of the rocks on the two walls. In southern British East Africa at Lage Magadi the western wall is a high, steep scarp, while the eastern side consists of a number of wide, flat steps due to parallel faults. At Lake Manyara, as the rocks on the eastern side are softer, the scarp has been dressed down to an even slope. This arrangement does not extend far; the eastern wall soon reappears, and, though Suess left a gap of 350 miles long between Lakes Manyara and Nyasa, the Rift Valley has now been traced across most of it.

That Nyasa is a Rift Valley basin has been proved by Andrews and Bailey. Its northern end is joined by the western branch, which includes Tanganyika, the Albert Nyanza, and the Upper White Nile. In the western branch the valley is in places irregular, as branches run off or the course is deflected along the grain of the country, to which that branch as a whole is oblique. South of the Zambezi the Rift Valley has been traced by Teale and Wilson, who have shown that a post-Eocene rift valley separates the Sheringoma plateau from the eastern front of Rhodesia. The long meridional section of the coast from Beira to Cape Corrientes appears to have been determined by the southernmost of the crustal movements of the Great Rift Valley.

The valley, therefore, extends from Lebanon to the Sabi River; its branches reach the mouth of the Gulf of Aden, and westward include the rift valleys of the Eastern Congo. Its length is about one-sixth of the circumference of the earth; hence it must have had some world-wide cause, the first clue to which is its age. The view that its history is geologically short commends itself by the freshness of its walls, by the legends of catastrophes, such as the destruction of Sodom and Gomorrah and the drowning of many villages on the formation of Tanganyika, having occurred along it during the time of man, and also by the fact that many of its faults are certainly recent. Nevertheless, the fuller evidence now available confirms the classification advanced in 1896, which attributed some of its lavas to the time of Chalk, and represented some of its faults as older than the uplift of the Alps. Some beds attributed to the Miocene on physiographical evidence are now proved of that date by the evidence of fossils. The rift valley of the Red Sea was certainly in existence by the Oligocene, and the southern end of the valley is shown to be of the same date by a fossil sea-urchin which has now been proved to be an East African species.

The history of the Rift Valley is largely dependent on the volcanic history of the country traversed. The first step in its formation was the uplift of a broad band of highlands extending from Palestine to Natal. The weakening of the support led to the collapse of the summit of this ridge. The sinking of the keystone caused volcanic eruptions along the adjacent fractures. The earliest of the great eruptions probably

[1] From a paper read before the Royal Geographical Society on January 5 by Prof. J. W. Gregory, F.R.S.

dates from the formation of the Arabian Sea and the breaking up of Gondwanaland, which originally included both India and Africa. These subsidences became more rapid about the end of the Chalk period, and led to volcanic eruptions on a colossal scale. On the eastern side of the foundered area were discharged the Deccan Traps, covering more than 200,000 square miles in India, and probably an equal area under the Indian Ocean. On the northern and western sides volcanic eruptions probably contemporary with the Deccan Traps formed the plateau-lavas of southern Arabia, Abyssinia, and the Kapite Plains in East Africa. These lava plains are older than the Rift Valley faults, and after them the East African arch fell in and initiated the Rift Valley; then followed eruptions from fewer vents building up higher volcanoes. They were followed by a lake period, the age of which is fixed by the remains of *Dinotherium Hobleyi* as Miocene.

That the whole volcanic history of British East Africa cannot be restricted to the post-Miocene is indicated by the evidence of Mount Kenya, since the glaciation of its valleys shows that they were in existence, the mountain had been deeply dissected before glacial times. It is incredible that the long volcanic history of the country, from the oldest plateau-lavas to the reduction of Kenya to its present form, should be restricted to only one period, the Pliocene.

If the first eruptions of the Rift Valley area were contemporary with the Deccan Traps, and therefore of the age of the Chalk, and the faulting lasted from the Oligocene to the Pliocene, the formation of the Rift Valley was connected with two great systems of earth movements, the foundering of the Indian Ocean and the uplift of the Alpine and Himalayan mountain systems. During the Mesozoic a slow deformation of the earth's crust caused the downward sagging of the North Polar regions and the buckling of the tropical and temperate zones by broad folds running east and west. Then elevation on lines trending north and south raised the East African highlands, while the collapse of the floor of the Indian Ocean caused widespread volcanic disturbances round the Arabian Sea. Later earth movements, which lasted for about the same time as the faulting of the Rift Valley, buckled the crust into the fold mountains of Europe and Asia. This corrugation was due to pressure, which in Europe was northward and in Asia southward. The reversal of direction may be explained by the difference in structure between Eur-Africa and Asia. Africa was a high plateau undergoing further uplift, while regional subsidence was taking place in and off northern Europe. The combined subsidence to north and uplift to south left Europe laterally unsupported on the north: the crust north of Africa was pressed northward, and buckled the country in front of it into fold mountain chains. In Asia the conditions were reversed; the massive plateau was to the north, and the sinking area was to the south in the Indian Ocean; so Asia was corrugated by a southward movement. The reversal from the European to the Asiatic direction occurred near the Sea of Azov and due north of the Rift Valley, which is the rift between the segment of the earth moving northward and that moving southward.

The structural contrast between Africa and America, due to the difference between the later mountain-forming movements, is explained by the fact that Africa is antipodal to the Pacific Ocean, and by the well-established principle that antipodal areas of the crust are subject to contrary conditions. While the Pacific was sinking, Africa was being upraised. The subsidence of the Pacific buckled its borders into the fold mountain chains of Western America, and those of which fragments can be traced from Japan to New Zealand. As Africa was being stretched by its uplift, and left unsupported on each side by the foundering of the adjacent oceans, it was rent by fractures between which the summit of its highlands fell in and formed the Great Rift Valley. "There may," says Sir George Adam Smith, "be something on the surface of another planet to match the Jordan Valley; there is nothing on this." That remark may be extended to the whole Rift Valley; for, in addition to the other unique features of Africa, its Rift Valley has no parallel elsewhere on the globe. The character of that valley may be explained by the special stresses in Africa due to its position antipodal to the great subsidence of the Pacific Ocean, while its course was determined by the wrench in the crust between the segment in which the pressure was northward against Europe and that pressing southward from the Asiatic highlands towards the infallen basin of the Indian Ocean.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

A JOINT discussion with Section F (Economic Science and Statistics) and the Subsection of Psychology on "The Influence of the Six-hour Day on Industrial Efficiency and Fatigue" was opened by Dr. H. M. Vernon. It has been suggested by Lord Leverhulme that two six-hour shifts may be more economical than one eight-hour shift, because the former would obtain twelve hours' use of expensive machinery instead of only eight hours. Examples were given of cases in which shortening of the hours of labour had increased the output, but in other cases the output had been decreased. The determining factor seems to be the amount of muscular effort put into the work. Heavy muscular work can be speeded up for shorter hours to produce a greater output, but where heavy labour is not involved the production falls with shorter hours.

Mr. P. Sargant Florence gave statistics from the United States which supported the concluding portion of Dr. Vernon's paper. He further pointed out that the average age of the working population should be taken into account as indicating whether the labour was too long or too heavy. Noise in factories is particularly fatiguing.

Prof. E. L. Collis advocated a reduction of working hours for the sake of health, but said that it must be done slowly. Unequal distribution of wealth is being remedied, but output must be increased.

Sir Hugh Bell pointed out the difference between various trades. Where the labour bill is only a small part of the cost of the manufactured article, it is easier to increase wages than when wages form the main portion of cost. He objected to legislation and uninformed interference, because agreement between employers and employees had reduced the hours of labour without the bad effects of legislative interference.

Miss C. Smith-Rossie advocated a wider educational system on the lines followed by Denmark, so that more interest can be aroused in the working people, thus eliminating fatigue.

Dr. H. H. Dale opened a discussion on "The *Rôle* of Capillaries in the Regulation of the Blood-flow." Previously the control of the blood-pressure had been considered to be brought about by the state of contraction of the arterioles, but it is now necessary to discuss whether the capillaries may or may not take some part in the regulation. Small doses of histamine

cause a dilatation of capillaries if injected into the circulation, but fail to do so in a perfused organ unless both red-blood corpuscles and adrenaline are present in the perfusion solution. Large doses of histamine cause a condition like secondary shock. The blood accumulates mainly in the capillaries, so that, although the heart is beating vigorously, so little blood passes through the veins to reach the heart that the blood-pressure falls. Actual counting of capillaries by Krogh shows that during rest only a few capillaries contain blood. During activity many more open up, so that the volume of blood that can be accommodated in them is greatly increased.

The discussion was continued by Prof. W. M. Bayliss, Prof. E. H. Starling, Prof. A. D. Waller, and Prof. N. Noël Paton. The trend of the discussion was that the arterioles regulate the blood-supply to the larger areas, and that variation in the size of capillaries may allow more or less blood to accumulate in them, thus affecting both the local and general circulation.

Three papers on accessory food substances were read before the Section. Prof. W. D. Halliburton contrasted butter and margarine. Margarine can be made from various substances, but liquid oils must be hardened. The hardening process destroys fat-soluble vitamines, so that even if these are present at the outset they are absent from the finished article. Sophistication of food is dangerous because it may remove accessory food substances. Children should be given the butter and milk, as adults can better withstand the absence of fat-soluble vitamines.

Dr. E. M. Delf read a paper on the effect of heat on the antiscorbutic food substance. Heating rapidly destroys antiscorbutic substance, but orange-juice withstands heating better than most of the antiscorbutic substances.

Miss A. J. Davey recorded the effect of preservatives on the antiscorbutic substance. Lemon-juice is a much more powerful antiscorbutic than lime-juice. Lemon-juice was preserved by metabisulphite or by its own rind-oil. The latter is more stable, and retains its antiscorbutic effect for more than a year without much deterioration.

Prof. A. D. Waller demonstrated the decrease in the electrical resistance of the hand that takes place when a disturbance occurs in the central nervous system. Coughing, burning, or even threatening to burn the opposite hand causes a decrease in electrical resistance. Some people are more imaginative and respond more to the threat than to the actual stimulus, whilst others are more phlegmatic, and give the greater response to the actual stimulus. Prof. Waller also demonstrated the effect of walking, running, and swimming on the output of carbon dioxide.

Dr. H. E. Roaf read a paper on the pathology of pellagra. Pellagra is due probably to the unsuitable nature of the protein in the diet. The symptoms point to an interference with the sympathetic nervous system. No previous record is known of distinctive pathological changes in pellagra. The sympathetic nervous system showed marked plasmolysis of its ganglion cells. It is possible that the sympathetic nervous system may be affected by diet through the adrenal medulla. It is, however, necessary to investigate the condition of the sympathetic nervous system in other diseases. Dr. Roaf also showed readings of climatic conditions made in Egypt and in Palestine. Heat loss and the effect of clothing on heat loss were shown by readings made with Prof. Leonard Hill's katathermometer. The protection by clothing from sun radiation was measured by sun-radiation thermometers.

BOTANY AT THE BRITISH ASSOCIATION.

THE influence of the great war was distinctly to be noted in the character of the papers presented at the first post-war meeting. The Botanical Section was fortunate in having a president so well able to review the actual and potential plant resources of our Empire, and to lay stress upon the pressing necessity for their scientific development. This note was struck again in the Forestry discussion, which took place jointly with the Agricultural Section. To this discussion Prof. A. Henry contributed a paper on the afforestation of water-catchment areas. He urged the planting of all suitable portions of gathering grounds (which probably vary in different cases from 10 per cent. to 70 per cent.), largely on account of the paramount importance of ensuring the purity of the water-supply, which can so adequately and profitably be done by this means. The scheme practically necessitates co-operation between State and corporation for the acquirement of the necessary land.

What may be regarded as a real war paper was furnished by Capt. H. Hamshaw Thomas, who gave an account of the desert flora of Western Egypt some twenty-five miles north-west of Cairo. The small rainfall, coupled with hot days and dewy nights, constitutes a set of conditions unfavourable to plant-life, so that, unlike the sandy, rocky desert of Eastern Egypt and Sinai, the Libyan Desert includes vast stretches totally devoid of vegetation. The pruning effect of the "khamseen" or sand-storms is very marked, and reduces the plants to a dwarfed, tufted habit.

Other floral and ecological papers included the flora of the district of the London Clay, by Mr. Horace W. Moncton, and the northern invasions of New Zealand, with special reference to Lord Howe Island, by Dr. J. C. Willis. Mr. Moncton pointed out that the flora of the London Clay in the Thames basin differs greatly from that on contiguous areas of different geological formation, and he illustrated his point from the sedges. In addition to the twenty-eight species characterising the London Clay, there are some twelve others recorded, which, however, "do not seem to occur where the London Clay forms the *actual* surface," since "a covering of gravel or sand too slight to mark on a geological map is sufficient to alter the flora."

Dr. Willis added to his well-known series of observations and conclusions concerning the origin of floras data with regard to that of New Zealand and Lord Howe Island, which led him to conclude that the New Zealand flora includes a western invasion, which probably "followed the ridge upon which stands Lord Howe Island." In consonance with his general position, Dr. Willis put forward the view that the endemics of Lord Howe Island are furnished by the larger (older) families and genera.

Considerable general as well as local interest was raised in connection with Col. Godfrey's paper on the orchids of Hants and Dorset, and the members of the section were privileged to see on their expedition to the New Forest one of the rare orchids mentioned, viz. *Malaxis paludosa*. The author enumerated a surprising number of natural hybrids occurring in the district.

As part of the joint discussion with the Zoological Section in the field of Genetics, Mr. W. Brierley and Dr. Ruggles Gates presented papers in which notable contributions to our concepts of species and the transmission of characters were put forward. Mr. Brierley treated of species in relation to his study of fungi, and claimed that it is the inner *physiological constitution* rather than the chance *morphological facies* which

makes up the true species complex. It can be demonstrated that in certain fungi, at any rate, the morphological expression varies with every medium, *i.e.* with environment, and must rightly be regarded as a resultant of a comparatively fixed physiological constitution and a variable environment, *i.e.* of two sets of interacting physico-chemical factors.

In his paper on mutational *versus* recapitulatory characters Dr. Gates endeavoured to distinguish between new characters which result from nuclear changes in the germ-cell, which he classed as mutational and referred to as "a new Mendelian character," and new characters which result from "the impress of the environment," which he classed as recapitulatory and described as "gradually developed, involving adaptation to new conditions, and, if permanent, the principle of inheritance of acquired characters." He went on to say: "The theory of antithetic alternation of generations, which is widely held as regards archegoniate plants, implies a gradual lengthening in the sporophyte through the addition of cell-divisions to its subterminal stages. This can scarcely be supposed to have resulted from an alteration in the cell-unit."

Miss Saunders's paper on a graded series of forms in Matthiola added very important data bearing on the relation between continuous and discontinuous characters. She has traced the genetic origin of a perfectly continuous series of forms between the glabrous variety and the normal densely hairy plant. These were produced as the result of crossing the familiar glabrous variety with a rare half-hairy form. "The phenomenon is explicable on the supposition of multiple allelomorphs."

Dr. Scott, in a paper entitled "The Relation of the Seed-Plants to the Higher Cryptogams," discussed the prevailing view that the pteridosperms, and hence the spermophytes as a whole, are to be derived from some unknown group of ferns. Dr. Scott combated this view, and took the stand that "pteridosperms have always been distinct from any of the known phyla of vascular Cryptogams . . . parallel in important aspects to the ferns, but of unknown and remote origin." He adduced anatomical and geological evidence in support of his view.

Another morphological paper concerned itself with the vexed question of the nature and origin of the pith and inner endodermis in medullated ferns. Dr. McLean Thomson concluded from his extensive investigation of *Platyzoma microphylla* that it furnished very good proof of the intrastelar or potentially vascular nature of the pith in this form. Not merely does the basal protostele pass gradually into the medullated condition once in the development of the individual, as in many other forms, but in this species the protostelic structure appears again in later-formed regions.

In a paper entitled "Monocotyledonous Features of the Ranunculaceæ, with Special Reference to the Floral Structure," Dr. Salisbury reviewed the similarities met with in the two groups in relation to number of parts, *dédoublement*, meristic variation, apocarpy, nature of fruits, placentation, etc.

As the result of her extensive work on movable-cell inclusions or statoliths, Miss Prankerd has found that they may be (1) starch grains, (2) chloroplasts, or (3) crystals, and that the nucleus may move with these inclusions. Even when this is not so, the nucleus of the statocyte may be markedly differentiated from that of neighbouring cells.

Under the heading of "Mychorrhiza and the Ericaceæ," Dr. M. C. Rayne added to her former work new facts tending to establish obligate symbiosis in Vaccinium similar to that in Calluna, and raising the question of the possibility of nitrogen fixation by the fungus.

Prof. Priestley put forward a very important contribution to the theoretical consideration of the phenomenon of root-pressure, involving an ingenious use of the rapidly accumulating knowledge of the behaviour of a colloid gel in respect to its variability towards water. It is hoped that this important subject will come up again for discussion at the Cardiff meeting in 1920.

The formal meetings of the section were brought to a close by a semi-popular lecture of exceptional interest given by Prof. F. W. Oliver on Spartina and Poole Harbour. E. N. T.

EDUCATION AT THE BRITISH ASSOCIATION.

AFTER the presidential address by Sir Napier Shaw the Section settled down to discuss a varied and interesting programme, which attracted large and appreciative audiences throughout the week. It was a great disappointment that Sir A. Quiller Couch was unable to be present himself, but his paper on the teaching of English admirably expressed a need now widely felt by thoughtful teachers that English should be the root of all learning for an English-speaking child; that until the age of fourteen or fifteen he should practise the language natural to his mind in addition to one other; that the plainest, most everyday speech should be clear, expressive, accurate, graceful whenever possible, and at any rate decent; that a child should learn to define and clarify in his mind the terms in which he thinks, to think in real English, not in jargon. Therefore, to attain this, teachers should aim through English in preference to any foreign language, alive or dead. English should not be treated as a special subject, but should be the basis of all others. He deprecated the inordinate amount of time given in the lower forms to linguistics and mathematics, since these are mainly ancillary, the former to literature and history, the latter to natural science; they are formal studies, studies in the abstract, and lacking the content of the other three, employing processes alien to a child's thought.

Mr. W. D. Eggar read a paper on the teaching of English in relation to school science, and claimed that the teaching of English was as much the concern of the science master as that of any other master—perhaps more so, as he is concerned with the live end of the language. He strongly urged that a broader and more intelligent study of English should take the place of much of the mathematical and linguistic work in preparatory schools.

Prof. H. E. Armstrong opened a discussion on "Method and Substance of Science Teaching" by criticising the Government report on the position of natural science in the educational system of Great Britain. This report he thought would prove of little value to teachers, and not likely to influence educational opinion to any degree. He looked upon it as a lost opportunity for examining and utilising experiments already tried. He combated the absurd statement made in Paragraph 43 of the report: that the heuristic method involves the rediscovery by the pupil in his school hours of all that he may fairly be expected to know. The method does, however, involve neither more nor less than learning the art of inquiry. The method employed must be disciplinary—the method of science; scientific outlook must be acquired if scientific knowledge is to be of any avail.

On the same topic Sir Richard Gregory, although advocating heuristic methods, thought that the substance of instruction suffered from concentration upon method, and that laboratory work should be supplemented by a broad general course of descriptive lessons given quite independently of the practical work. Dr. E. H. Griffiths said he hesitated to accept this divorce of lecture and practical work. Mr. Mangham spoke of the neglect of biological science in education, and asked for a closer co-operation between the lecturers in various branches of science at the universities. Dr. Lilian Clarke gave some interesting details of a sound practical course of elementary science in girls' schools, showing how the spirit of inquiry can be aroused in botany as well as in chemistry. Her plea for more time should not go unheeded; for it is impossible to go far in such valuable work with only one to one and a half hours per week. Miss Shove discussed the necessity of a thorough course of elementary chemistry and physics preliminary to a botanical course.

A joint session was arranged with Section F, when a paper from Sir Herbert E. Morgan was read. The paper had for its theme the real need of the country for educated men in directing business affairs, men educated in the right way, with technical training added to sound general knowledge and broad views. Mr. C. R. Fay emphasised the value of university influence in business, and claimed that a central school for all branches of economic science at the university would co-ordinate effort and effect a rapid diffusion of new methods. Mr. H. N. Sullivan thought that young men entered business too early. Prof. Oldham described the work of the faculty of commerce in Dublin University. Sir Hugh Bell said that the bold step of appointing university men in railway business was a success, but that it was objected to by men whose promotion had thereby been affected.

A discussion on continuation schools was opened by Sir Robert Blair, who, speaking from the point of view of the largest urban district, suggested that for the first two years education should be general, and for the second two may have a technical or commercial bias derived from the occupation; that residence is the basis of obligation on the authority; that the required eight hours per week should be taken in two four-hour periods; that it would be inadvisable to divide the four-year period between two schools, one from fourteen to sixteen, the other from sixteen to eighteen; that schools may be mixed, not dual; that continuation schools will be ends in themselves and, for some, "stepping-stones" to higher things. Interest, he declared, is the key to the problem of instruction; the schools will be what the staff makes them. Extra class-room activities are no less important—libraries, clubs, games, and societies will attract the adolescent.

Mr. A. P. M. Fleming followed with a paper on works schools, in which he illustrated their advantages, such as the close correlation between the school work and the practical training in the works, the increased facilities for the selection for employment, promotion, systematic training, and for ensuring harmonious relations between the management and the worker. Mr. J. S. Rainer took a rather contrary view of works schools, and in a very able paper presented the W.E.A. point of view as being opposed to works schools. He contended that for efficiency and success these schools must be entirely independent of employers' control; for distrust of the employing interest, as being almost entirely personal and mercenary, would prevent such schools from giving suitable and adequate education. The subjects of study must be related to the interests of the pupil, and not determined by the needs of trades or industries. Mr. G. F. Daniell dealt with the problem in rural districts, and pointed out the need for transport facilities. He urged close relations with the village clubs and institutes, and thought that attendance could be arranged either for one day per week for forty weeks, or for a seasonal attendance. Mr. C. A. Buckmaster pleaded for full liberty to the teachers and for the provision of school societies and games, and thought that the content of the curriculum was secondary to the training of character. Lord Malmesbury advocated the gradual elimination of those unable to profit by the education provided out of public funds, but would encourage and spend as much as possible on the best boys and girls.

Dr. Vincent Naser, of Copenhagen, submitted proposals for an exchange of students between Denmark and Great Britain, and suggested the formation of bureaux of international information in connection with universities.

Sir Richard Gregory spoke on the educational value of the kinema—not to make learning easy, but to awaken interest and synthesise instruction. An exhibition of some instructive films was given by the Community Picture Bureau.

Bishop Welldon, in opening a discussion on training in citizenship, said that something must be done through co-operation or co-partnership to create a fellow-feeling between capital and labour, and that an enlightened patriotism as well as the dignity and history of the Empire should be taught.

Lt.-Gen. Sir Robert Baden-Powell made an eloquent appeal for the need of out-of-school training and environment as auxiliary to education for producing efficient human citizens. The wonderful success of the Boy Scout movement suggests that the most important duty of the schoolmaster is to discover what particular portion of his environment appeals most to each of his pupils, and to use that as the medium for inducing mental activity.

In a valuable paper on fundamental principles in education Prof. A. N. Whitehead claimed that all education is the development of genius, and showed that the true ultimate problem before the educator is how to impart knowledge so as to stimulate genius. He showed that language is essential, but argued that a child should not study a dead language until a modern literature has gripped the imagination; that classical learning is the superstructure of a literary education, and not the foundation.

Mr. F. S. Preston submitted a paper in which he emphasised the value of literary studies in the development of imagination and the moral faculties. A paper from Prof. Marcus Hartog on the function of examinations in education followed.

The final sitting of the Section was occupied with two excellent papers on the present position of private schools in the educational system, one by Mr. R. H. Hume, the president of the Private Schools Association, the other by Mr. Alex. Devine. These papers, and the discussion that followed, brought out the fact, little realised by many, that the number of children educated in private schools approaches in many places 50 per cent. of the school population.

Reports by special committees of the section were read and discussed, that on the free-place system by Mr. C. A. Buckmaster and Mr. D. P. Berridge, that on museums by Mr. Herbert Bolton, and that on the registration of schools by Lady Shaw—all embodying valuable information and suggestions for the educational reformer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN connection with the London County Council addresses to teachers on recent developments in science, Dr. W. Bateson will give a lecture on biology at King's College, Strand, W.C.2, on Saturday, January 24, at 11 a.m. The chair will be taken by Dr. S. Russell Wells, Vice-Chancellor of the University of London.

A WHITE Paper (Cd. 221, 1919) just issued sets forth the proposed text of the Order in Council by which, subject to the approval of Parliament, certain powers and duties in relation to public libraries, museums, and gymnasiums, formerly exercised by the Local Government Board and latterly by the Ministry of Health, are to be transferred to the Board of Education. This forms part of the proposal made by the Reconstruction Committee on Adult Education, to which, as we have previously recorded (NATURE, October 9, 1919), exception was taken by the museum officials and librarians. On the face of it, however, the proposed Order seems unobjectionable and, indeed, natural. The powers in question relate to the making of various by-laws and to the sales of buildings or land, and there can be no ground for supposing that they will be exercised in other than a liberal spirit conducive to the best ends of the institutions concerned. The questions of financial control, apportionment of rates, and general management do not seem to fall within the scope of this Order, and nothing is said in it about bringing museums and libraries under the control of the local education authorities. At the same time, the present step may be regarded as only the first of a contemplated series, and as, in any case, the necessary preliminary to those more fundamental changes concerning which opinions differ.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, December 15, 1919.—Prof. A. W. Porter, vice-president, in the chair.—A. G. **Tarrant**: The measurement of physical properties at high temperatures. An account is given of experiments made upon refractory materials with the view of measuring certain physical properties at high temperatures, particular attention being paid to thermal expansion, tensile strength, and thermal conductivity.—Lieut. W. A. **Macfadyen**: An aspect of electrolytic iron deposition. The experiments detailed were carried out in seeking the best conditions for obtaining thick, hard, adherent deposits of iron on steel-mechanism parts which had been machined too much or worn down in a few places, and thus rendered useless, so as to enable the scrapped parts to be replaced in use after treatment.—J. G. **Williams**: The electrolytic formation of perchlorate. It is pointed out that present practice in electrolytic preparation of perchlorate uses much higher temperature of liquor and current density than is given in text-books.—Prof. A. W. **Porter**: The vapour pressure of binary mixtures. In order to remove difficulties in connection with the proof of the Duhem-Margules formula for the vapour pressures of binary mixtures, a simplified proof is given which makes clear the extent of the usual approximations in each step of the proof.—Prof. E. D. **Campbell**: The solution theory of steel and the influence of changes in carbide concentration on the electrical resistivity. Baly's force-field theory is applied to the case of the solid solution of the non-ferrous elements in steel. The experimental portion of the paper describes a research on the influence of the decarburisation by means of hydrogen of a series of alloy steels on the electrical resistivity, when the metal is in both the annealed and hardened condition.—S. **Horiba**: Some relations between the solubilities of solutes and their molecular volumes.—Dr. E. J. **Hartung**: (1) An accurate method for the determination of vapour pressure. (2) Some properties of copper ferrocyanide.

PARIS.

Academy of Sciences, December 15, 1919.—M. Léon Guignard in the chair.—H. **Douvillé**: The annular Foraminiferæ (Cyclostègnes) of Orbigny. The annular development taken by Orbigny as a basis of classification is the result of a particular mode of growth, and is a secondary character.—G. **Bonnier**: Comparative culture of seedlings at high altitudes and in the plain. After experiments, lasting thirty or thirty-five years, low-level plants grown on the same soil at different altitudes acquire completely the form and structure of plants of the same species growing naturally at the higher altitude. Detailed examples are given.—E. **Ariès**: A new improvement of the equation of state of fluids.—V. **Grignard**, G. **Rivat**, and Ed. **Urbain**: The chloro-derivatives of methyl formate and carbonate.—G. **Friedel**: The calculation of the intensity of X-rays diffracted by crystals.—M. Louis Lumière was elected a member of the division of the applications of science to industry.—M. **Plancherel**: The method of integration of Ritz.—J. **Drach**: Determination of the first integrals of the differential equation of geodesic lines, rational with respect to the first differential of the unknown function.—Ed. **Fouché**: A characteristic equation for atmospheric air.—P. **Jolibois**: A new method of physico-chemical analysis of precipitates. Application to the study of the calcium phosphates.—A. **Recoura**: A new complex form of chromic sulphate.—A. **Kling**, D. **Florentin**, A. **Lassieur**, and E. **Schmutz**: The properties of the chloromethyl chloroformates.—M. **Godchot** and F. **Taboury**: Some new bicyclic ketones. Further applications of the reaction between ketones and calcium hydride.—L. **Bertrand** and A. **Lanquine**: The relations between chemical composition, microscopic structure, and the ceramic qualities of clays. The usual method of calculating the proportion of mica in clay from the chemical analyses can be shown by microscopic examination to be erroneous. The chemical composition of a clay is an insufficient guide to its ceramic properties.—R. **Anthony**: The determination of the lobulation of the kidney in mammals.—A. **Pézard**: Alimentary castration in cocks submitted to an exclusively carnivorous diet. A strictly carnivorous diet sets up a slow intoxication to which the genital glands are peculiarly sensitive. The latter are either atrophied or do not develop.—R. **Bayeux**: The urinary toxicity and its modifications by hypodermic injections of oxygen during a prolonged stay at the Mont Blanc Observatory.—F. **Bordas**: Milk contamination. Remarks on the importance of reducing infant mortality, with especial reference to tuberculosis produced by dirty milk.—P. **Achalme** and Mme. **Phisalix**: The preservation of vaccine.

BOOKS RECEIVED.

The Child's Unconscious Mind. By Dr. W. Lay. Pp. vii+329. (London: Kegan Paul and Co., Ltd.) 10s. net.

The Elements of Analytical Conics. By Dr. C. Davison. Pp. vii+238. (London: At the Cambridge University Press.) 10s. net.

A Geographical Bibliography of British Ornithology from the Earliest Times to the End of 1918. By W. H. Mullens, H. Kirke Swann, and Rev. F. C. R. Jourdain. Part ii. Pp. 97–192. (London: Witherby and Co.) 6s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. R. R. Terry: Renaissance Music in Italy and England (with Musical Illustrations).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

LONDON MATHEMATICAL SOCIETY, at 5.—Major P. A. MacMahon: The Divisors of Numbers.—H. Steinhaus: Fourier Coefficients of Bounded Functions.—S. P. Owen: The Lag of a Thermometer in a Medium whose Temperature is a Linear Function of the Time.

LINNEAN SOCIETY, at 5.—Dr. B. Daydon Jackson: Methods of Botanic Illustration during Four Centuries (Lantern Lecture).

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. E. W. Hope: Schemes and Methods in Tuberculosis Work.

CHEMICAL SOCIETY, at 8.—L. E. Hinkel and H. W. Cremer: The Condensation of Acetoacetic Ester with *p*-Dimethylaminobenzaldehyde and Ammonia.—G. S. Butler and H. B. Dunnicliff: The Action of Alcohol on the Sulphates of Sodium.—M. Nierenstein, C. W. Spiers, and, in part, the late K. C. R. Daniel: Guarana Tannin.—R. Lessing: Studies in the Composition of Coal: (1) The Behaviour of the Constituents of Banded Bituminous Coal on Coking; (2) The Mineral Constituents of Banded Bituminous Coal.—P. Ray and P. V. Sarkar: The Hydrazino-thiocyanates of certain Divalent Metals.

FRIDAY, JANUARY 16.

INSTITUTE OF AERONAUTICAL ENGINEERS (at the Holborn Hall), at 2.30.—Prof. G. H. Bryan: Presidential Address.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 5.—Dr. A. A. Gray: A Few Anatomical Details of the Anatomy of the Vestibule, not previously described.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—R. B. Dunwoody: The Economic Requirements for Inland Navigation Transport in the British Isles (Vernon Harcourt Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at the City and Guilds (Engineering) College), at 7.—J. H. Reyner: The Development of Automatic Telephony.

JUNIOR INSTITUTION OF ENGINEERS (at 39 Victoria Street), at 7.30.—B. E. D. Kilburn: Meteorology and Engineering.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—C. Thurstan Holland: Lessons of the War.

SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.30.—Dr. P. Manson-Bahr and Others: Discussion on Bacillary Dysentery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. Sir James Dewar: Low Temperature Studies.

SATURDAY, JANUARY 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Noyes: The Anglo-American Bond of Literature.

MONDAY, JANUARY 19.

VICTORIA INSTITUTE (Committee Room B, Central Hall, Westminster), at 4.30.—Dr. A. T. Schofield: The Psychology of the Female Mind.

ROYAL COLLEGE OF SURGEONS, at 5.—Prof. A. Keith: John Hunter's Observations and Discoveries in Anatomy and Surgery; His Contributions to our Knowledge of the Heart and Blood Vessels (Hunterian Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.—S. M. Hills and Others: Discussion on Functions of a Trade Journal.

SURVEYORS' INSTITUTION (Junior Meeting), at 7.—R. E. A. Dash: The Housing Question and how it is affected by Recent Regulation.

ARISTOTELIAN SOCIETY (at 74 Grosvenor Street), at 8.—Prof. J. A. Smith: The Philosophy of Giovanni Gentile.

ROYAL SOCIETY OF ARTS, at 8.—Capt. H. Hamshaw Thomas: Aircraft Photography in War and Peace (Cantor Lecture).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Lt.-Col. J. Tilho: Tibesti to Darfur.

TUESDAY, JANUARY 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. Sir John Cadman: Modern Development of the Miner's Safety Lamp.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—J. Barcroft and Others: Discussion on the Therapeutic Uses of Oxygen.

ROYAL STATISTICAL SOCIETY, at 5.15.—G. H. Knibbs: The Organisation of Imperial Statistics.

MINERALOGICAL SOCIETY, at 5.30.—Dr. E. S. Simpson: Gearksutite at Gingin, Western Australia.—C. E. Barrs: Fibroferrite from Cyprus.—Dr. G. T. Prior: The Classification of Meteorites.—A. F. Hallimond: On Torbernite.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—H. Moore: Spontaneous Ignition Temperatures of Liquid Fuels.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Technical Meeting), at 7.—T. H. B. Scott: Pictorial Suggestions.

WEDNESDAY, JANUARY 21.

ROYAL SOCIETY OF ARTS, at 4.30.—A. H. Powell: Ancient Cottages and Modern Requirements.

ROYAL METEOROLOGICAL SOCIETY (at the Royal Astronomical Society) (Annual General Meeting), at 5.—Sir Napier Shaw: Pioneers in the Science of Weather (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Occasional Lecture), at 5.—Surg.-Comm. K. Digby Bell: The Position of the Medical Profession with regard to National Physical Education.

ROYAL COLLEGE OF SURGEONS, at 5.—Prof. A. Keith: John Hunter's Observations and Discoveries in Anatomy and Surgery; His Contributions to our Knowledge of the Lungs and Pleuræ (Hunterian Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

ROYAL AERONAUTICAL SOCIETY (at the Royal Society of Arts), at 8.—A. P. Cole: Principles of Rigid Airship Construction.

ROYAL MICROSCOPICAL SOCIETY (Annual Meeting), at 8.—J. E. Barnard: The Present Status of Microscopy (Presidential Address).

THURSDAY, JANUARY 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. R. R. Terry: Renaissance Music in Italy and England.

ROYAL SOCIETY, at 4.30 (Special General Meeting). At 4.30.—Prof. E. G. Coker and K. C. Chakko: The Stress-strain Properties of Nitro-cellulose and the Law of its Optical Behaviour.—S. Marsh: Alternating-Current-Electrolysis.—W. H. Eccles and J. H. Vincent: The Variations of Wave-length of the Oscillations Generated by the Three-Electrode Thermionic Tube due to Changes in Filament Current, Plate Voltage, Grid Voltage, or Coupling.—S. D. Carothers; Plane Strain. The Direct Determination of Stress.—F. Horton and Ann C. Davies: An Investigation of the Effects of Electron Collisions with Platinum and with Hydrogen, to ascertain whether the Production of Ionisation from Platinum is due to Occluded Hydrogen.—L. Bairstow, R. H. Fowler, and D. R. Hartree.—The Pressure Distribution on the Head of a Shell moving at High Velocities.

INSTITUTION OF MINING AND METALLURGY (at the Geological Society), at 5.30.—W. Broadbridge: Froth Flotation: Its Commercial Application and its Influence on Modern Concentration and Smelting Practice.

INSTITUTION OF ELECTRICAL ENGINEERS (at the Institution of Civil Engineers), at 6.—J. L. Thompson: Transformers for Electric Furnaces.

FRIDAY, JANUARY 23.

PHYSICAL SOCIETY OF LONDON (at the City and Guilds Technical College, Leonard Street), at 5.—Dr. J. H. Vincent: Maintained Oscillations in Triode Valve Circuits.—Dr. W. Eccles: Measurements of the Chief Parameters of Triode Valves.—F. W. Jordan: Measurement of Amplification of a Radio-frequency Amplifier.—F. E. Smith: The Measurement of Amplification given by Triode Amplifiers at Audible and at Radio Frequencies.—Hon. C. W. Stopford and C. R. Darling: Exhibition of a Method of Determining the Hardening Temperature of Steel.—C. R. Darling: Exhibition of a Thermal Cell of Constant Voltage.

ROYAL COLLEGE OF SURGEONS, at 5.—Prof. A. Keith: John Hunter's Observations and Discoveries in Anatomy and Surgery; His Contributions to our Knowledge of the Alimentary System (Hunterian Lecture).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—E. M. Bergstrom: Recent Advances in Utilisation of Water Power.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. F. G. Crookshank: Principles of Epidemiology.—Dr. Cleland and Dr. Campbell: Epidemiology of Acute Encephalomyelitis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Hon. Sir Charles Parsons: Researches at High Pressures and Temperatures.

SATURDAY, JANUARY 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Noyes: Aspects of Modern Poetry.

PHYSIOLOGICAL SOCIETY (at King's College), at 4.

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